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ROENTGEN KYMOGRAPHIC STUDY OF THE ALTERATIONS IN THE PATHOLOGICAL HEART DURING VALSALVA AND MÜLLER TESTS[1]

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TRANSLATION BY MYRON WRIGHT

THE radiological study of the variations in the form of the heart following the procedures of Müller and Valsalva was made for the first time by Crowden and Harris (1) in a very artificial manner which was not comparable with routine clinical procedures. In the Valsalva test they noted a decrease in the size of the heart because of the difficulty in entrance of the blood into the heart due to an increase in intrathoracic pressure. On the basis of Müller's test, they found that the increase in cardiac volume was due to the increase in blood flow to the ventricles when the intrathoracic pressure was diminished. These results are in consonance with the findings of the physiologists.

Subsequently, Roesler (2) confirmed these findings radioscopically and noted that during Müller's test the volume of the vena cava also increases. He expressed simply the mechanism of the increase in heart volume, by saying that in the Müller test there is an increase in the normal suction effect which the lung exerts on the heart, while, during the Valsalva test, this is diminished.

The first one to study these tests roentgenographically was I. S. Hirsch (3), who noted that in normal humans alterations could be produced artificially which were identical with those observed in some of the cardiopathies. He also showed that during Müller's test the cavities adapt themselves to an overfilling, such as exists in the right ventricle in pulmonary stenosis; that the amplitude of the waves of the vena cava is increased, and that the aortic movement diminishes. During Valsalva's procedure the cardiac cavities adapt themselves to a smaller flow of blood, emptying the ventricles progressively and diminishing the amplitude of auricular and ventricular beats.

Bordet and Fischgold (4) studied the left ventricle roentgeno-kymographically during Valsalva's test and recorded a decrease in its volume, and in the amplitude of its waves, and an increase in cardiac rate.

In a monograph published in 1936 (5), and subsequently in a study in some cases of the systolic movement at the levels of the ventricles of the heart (10), I studied the modifications of the normal and pathological roentgen kymograms, during both tests from the point of view of the underlying lesions, by the concentric kymographic method. This is, in my opinion, the most appropriate method for the study of the waves at the level of the auricles and ven-

[1] This is one of a series of papers contributed by friends and former pupils of I. Seth Hirsch, M.D.

tricles because the slits are in such a position that they almost cut the borders of the heart perpendicularly, if one has taken the precaution of centering correctly.

MATERIAL AND TECHNIC

The material for this work was selected from the patients in the Radiological Diagnostic Service of Heart Diseases of the

Fig. 1.

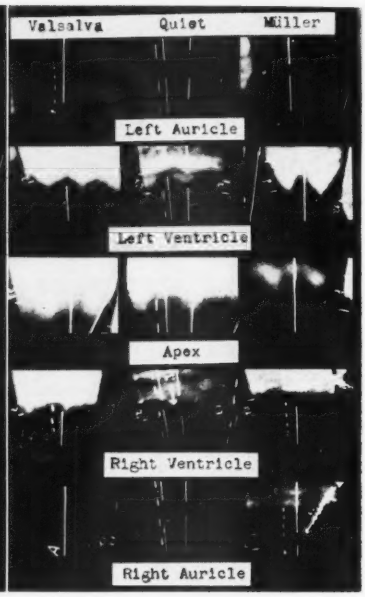


Fig. 2.

Fig. 1. Kymogram of an athletic, muscular, adult male 18 years of age. The heart is normal and there is no previous cardiac history. Diameters: Valsalva, 11.2; Quiet, 12.8; Müller, 13.4. At rest, the auricular impulses are normal, with the major and minor systolic retraction synchronous with the opening of the auricular-ventricular valves. The major filling is seen post-systolic. During the procedure of Müller it is pre-systolic and during the procedure of Valsalva the systolic retraction alone is visible. The left ventricular waves at rest are normal with all the characteristic contours. During the procedure of Valsalva the reduction of the diastolic contours may be observed. During the procedure of Müller the diastolic and systolic periods are accentuated with an increase in the amplitude of the waves which are, however, reduced in the procedure of Valsalva. At the lower border on the right side typical right ventricular waves may be observed (transmitted by the auricle). In the auricle there may be observed impulses similar to those of the left ventricle with the difference that during the procedure of Valsalva the diastole is almost entirely isometric, with complete filling of the ventricle at the end of diastole. During the procedure of Müller the rapid diastole is accentuated. In the right auricle similar phenomena are to be observed with the difference that the maximum expansion during the procedure of Valsalva is post-systolic and in Müller it is pre-systolic.

Fig. 2. Kymogram of a man of 32 years of age with a previous history of rheumatic infection in childhood and with pronounced dyspnea on effort and hemoptysis of one month's duration. Pulmonary examination was negative. The heart findings are those of mitral stenosis with enlargement of the left auricle, a small left ventricle, and abnormal prominence of the pulmonary artery and its branches, with hypertrophy of the right ventricle toward the midline and increase in volume of the right auricle. The heart measurements: Valsalva, 15.1; Quiet, 16.8; Müller, 16.2. There is disappearance of the waves of the left auricle during the procedure of Valsalva and in the Müller tests a substitution by waves of auricular and ventricular type. The waves of the left ventricle reveal the diastolic characteristics of mitral stenosis during the procedure of Valsalva, while during the procedure of Müller they show a normal outline. At the apex and at the lower part of the right border, the right ventricle shows rapid and brisk filling and prolongation of the isometric phase of diastole. These diastolic characteristics are accentuated during the procedure of Müller and reduced during the procedure of Valsalva. No waves were observed in the right auricle in any of the procedures.

Institute of Radiology of the Medical Faculty of Montevideo. They were referred to this service principally from the Cardiac Clinic of Professor J. Montes Pareja, from the medical clinics and wards of Maciel Hospital. Adult patients with practically all types of cardiac lesions were examined and were divided and classified in groups according to the clinical diagnosis. From a group of 3,200 patients were separated those with the clearest clinical picture of pure cardiopathies, and from these a selected number were studied roentgeno-kymographically. From each group so examined, the most typical case was selected because it showed the changes characteristic of the entire group, and then from these cases the most interesting ones were separated to serve as a basis for this work. In the accompanying Table I can be seen the cardiopathies studied, some of them being based on the degree of cardiac insufficiency presented by the patient, and some based on special anatomic alterations which I desired to study.

I have utilized a concentric roentgen kymograph, a modification of the original one of Stumpf (6), which has been described in a previous publication (8). In this apparatus the screen is a steel wheel which contains in its interior thin lead sectors that limit triangular slits, each one of them being 19.5° from the ones on either side of it. These radial slits have a progressively increasing width from the center to the periphery, but not in strict relation with the radius, the purpose of this being to counterbalance the greater transparency of the lung: at 2 cm. from the center the slits are 0.2 mm.; at 4 cm. they are 0.4 mm.; at 6 cm. they are 0.5 mm., and at 12 cm. they are 0.8 mm. wide. The width of the lead sector at 6 cm. from the center is 2 cm. This corresponds to the place where the upper level of the cardiac silhouette usually cuts the slit. Ample tracings can be obtained by this method by using a rotary velocity which permits the coverage of a sector in from 1.33 and 1.6 second. This makes it possible to register two complete cardiac revolutions per sector.

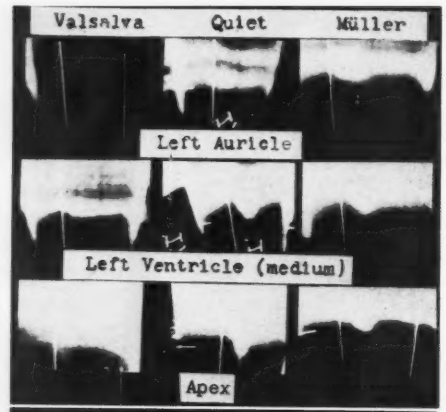
The plate holder with a radiographic film is in a second steel wheel, concentric with the first, and both rotate, supported at the periphery by little wheels, one of these being attached to a synchronized electric motor making it possible to obtain perfectly regular circular movement.

With a special arrangement it is possible to make either one of the steel wheels rotate, obtaining by means of rotating the screen wheel a plane or surface kymogram or when the wheel holding the film rotates, a lineal or step kymogram.

In this work I have reproduced only step kymograms, which are best adapted for this study. In all the sectors obtained a line of reference has been marked which corresponds to the beginning of systole. This was done with a special "comparator" or scale that I previously described (5). This scale is a celluloid film with radiating lines which correspond exactly to one of the edges of the slits. This scale is held on a fixed projection mounted at the center of an ordinary illuminating box, taking care that the point perforates its exact center. The kymographic film is pierced at its exact center, which brings the scale in proper relation with the negative. Finally the negative is rotated in the direction of the course of the tracing to the desired point and then the line of the "comparator" is marked on the negative with India ink. In some kymograms, such other points of the cardiac cycle may be marked as may be of interest in the consideration of the different cardiac chambers.

The distance between the tube and the film was commonly 36 inches. A 10 kw. tube working with 100 ma. and from 80 to 100 kv.p. was used. An anti-diffusion cone was always used (improves the tracings) and modern high speed screens and films, and a longer processing of the film.

The center of the system was placed inside the cardiac shadow at a distance from the borders proportional to the amplitude of movement as observed radioscopically, in order to obtain the greatest length of record in those parts of the contour which have the greatest amplitude.



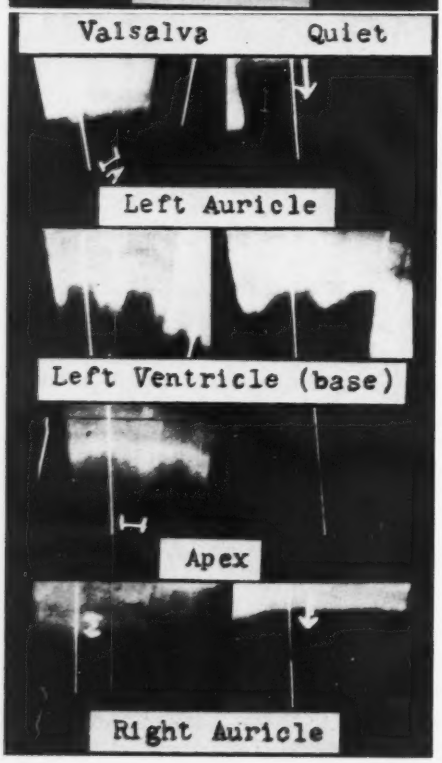


Fig. 3 (*top*). Kymogram of a 24-year-old man with previous history of rheumatic infection in childhood with minimal signs of cardiac insufficiency. There is alteration of the first sound with a soft blowing murmur at the apex. This was more intense in childhood and had the character of mitral insufficiency. Heart measurements: Valsalva, 12; Quiet, 14; Müller, 15.6. The waves of the left auricle are strongly influenced by the ventricular overfilling during the procedure of Müller. In the upper part of the left ventricle, the diastolic waves are normal at rest, with the waves typical of mitral stenosis being seen during Valsalva's procedure, and waves of mitral insufficiency being seen during the procedure of Müller, while at the apex, at all times the characteristics of the insufficiency may be observed. These are smaller in Valsalva and little reduced in Müller.

Fig. 4 (*middle*). Kymogram of a 27-year-old man with atypical acute attack of polyarticular rheumatism of two months' duration without previous cardiac involvement. Beginning one week before admission he had had dyspnea on exertion and presented the typical blowing murmur of mitral insufficiency at the apex. The diameters: Valsalva, 13; Quiet, 15.1; Müller, 15.1. The typical left auricular waves are greatly influenced by the ventricular without observable regurgitation. At rest, there is a protodiastolic expansion that terminates with the opening of the auricular-ventricular valves. The left ventricle revealed the typical diastolic and systolic picture of mitral insufficiency without an isometric period and with contractions which are rapid, brisk, and deep in apnea and during the Valsalva test. During the procedure of Müller they approach an isometric period and the contraction is less deep and more prolonged. In both tests the amplitude of the waves decreases.

Fig. 5 (*bottom*). Kymogram of a young woman 25 years of age with acute and rapidly progressive rheumatic heart disease. Physical examination revealed an intense systolic murmur at the apex, reflected over the precordium and which has the characteristics of mitral insufficiency. Heart measurements: Valsalva, 17; Quiet, 18.5. The waves of both auricles are conspicuous while at rest and a wave of systolic regurgitation which almost disappears on the left becomes more evident on the right during the procedure of Valsalva. At rest, the expansion of the left auricle is so large that it appears synchronous with the systolic ventricular contraction of the middle section of the ventricle.

RESULTS

Three step kymograms were studied in almost all the cases: the first in quiet respiration (Q); the second, six seconds following Valsalva's procedure (V)—forced inspiration, closing of the glottis, followed by forced expulsive effort with the thoracic and abdominal muscles without permitting the exit of air—and finally the third was obtained six seconds after Müller's test (M), (forced expiration, closing the glottis, forced inspiratory effort without permitting the entrance of air). The patients were

rehearsed prior to the exposure and then those kymograms were discarded in which an increase in the transverse diameter during Müller's procedure and a decrease during Valsalva's procedure were not noted. Those cases, however, in which the position was markedly changed were kept, since tests have shown that there are not only changes in volume of the chambers but also changes in position of more or less importance and magnitude in accordance with the findings of Bordet and Fischgold (4). In the doubtful cases the variations in rate were observed, since normally during Valsalva's test there is definite acceleration and, during Müller's, a slowing of the heart.

The reduction of volume during Valsalva's test affected the transverse diameter (measured between the extreme lateral points of the contours). In normal cases the reduction varied from 10 to 14 per cent. In the Müller procedure the increase was only 8 per cent.

In the pathological cases in the Valsalva test, the maximum decrease observed was 17 per cent in some patients with myocardial infarcts classified kymographically as aneurysms of the lateral wall of the left ventricle, without deformity of the silhouette. In well compensated cases of mitral insufficiency the maximum decrease was 15 per cent. The least decreases in the transverse diameter during Valsalva's test were observed in double mitral lesions, with or without lesions of the pulmonary artery, in the multivalvular lesions in pulmonary stenosis, and in the myocardial diseases with a small heart.

The increase in transverse diameter during the procedure of Müller, studied in the pathological cases, may reach 11 per cent, as in the pure aortic insufficiencies and in aneurysm of the ventricle. In the Müller test the minimal increases were observed in mitral stenosis, in mitral insufficiency with cardiac insufficiency, in mitral insufficiency and narrow aorta, in the multivalvular lesions, and in pulmonary stenosis.

In some cases, changes in the amplitude of the beats of the left ventricle were observed during the tests, there being no increase during the Müller test and a decrease from the normal during Valsalva's. In all the cases of mitral insufficiency with cardiac insufficiency (with or without other valvular lesions), the amplitudes were not increased during Müller's procedure.

Normally, the form of the waves of the left ventricle varied during the test. In Valsalva's test the diastole becomes progressively slower, and systole more forceful during the period of rapid ejection; while the diastolic periods were more marked and systole was prolonged during the Müller test. In some cases, the shape of the waves varied beyond normal limits. This was most marked in well compensated mitral insufficiency and in aortic insufficiency, in both of which, during Valsalva's test, the diastole assumed a normal aspect. In mitral stenosis with aortic insufficiency, in the resting state, the waves were normal, but during Valsalva's test, they were typical of mitral stenosis and during Müller's test they resembled the waves of mitral insufficiency.

At the apex, the changes were relatively more frequent when the left ventricle formed the apex. In the few cases in which the right ventricle formed it, there were no variations in the normal amplitude. In the majority of these, the amplitude of the beats decreased instead of increasing during Müller's test, thus not being parallel with the amplitudes of the right ventricle studied at the point where the right auricle meets the right ventricle in the right border of the cardiac silhouette.

Pathological changes of the pericardium greatly affect the kymographic waves. In cases of adhesions, kymographic changes may be observed which are in agreement with auscultatory phenomena.

In the four cases of small pericardial effusion studied, the diagnosis was possible in life by means of two radiological signs: (1) the double contour of the cardiac silhouette, and (2) a characteristic alteration of

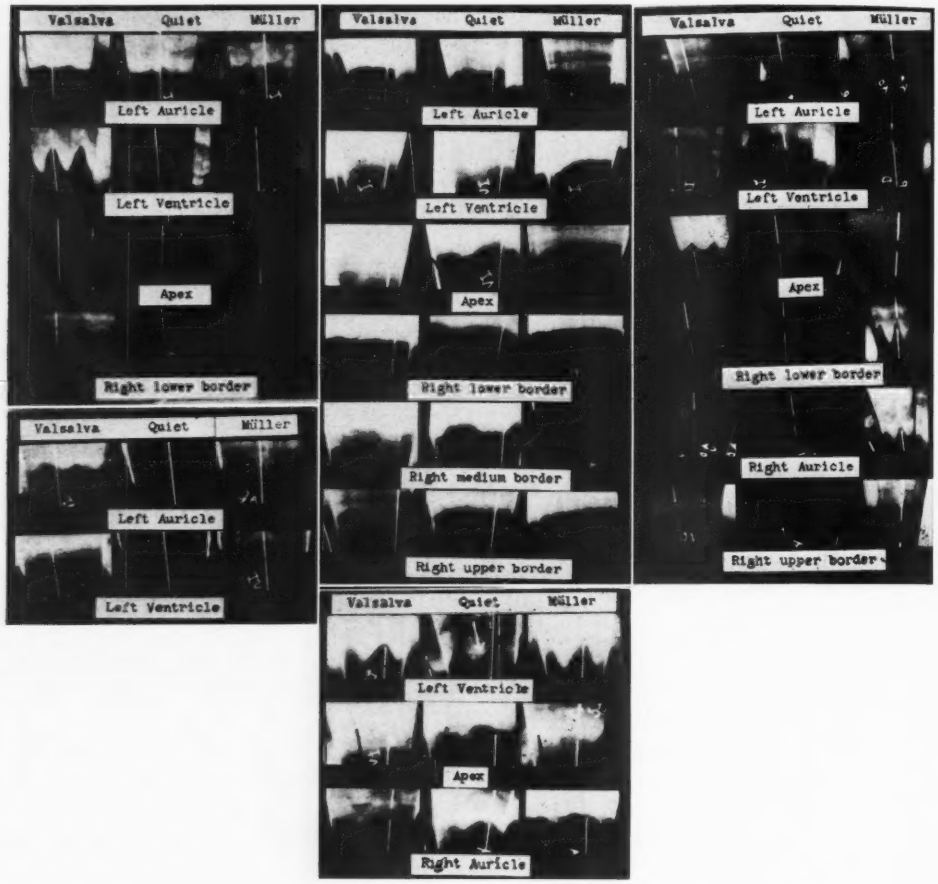


Fig. 6 (*upper left*). Kymogram of a woman, 20 years of age, with a double mitral lesion and without cardiac insufficiency. Heart measurements: Valsalva, 18.8; Quiet, 18.9; Müller, 19.3. Kymographic study of the left auricle reveals a reflux wave which disappears during the procedure of Valsalva and creates a sluggish auricular flow which increases in speed with the approach of systole. During the procedure of Müller, the amplitude of the waves is increased. The left ventricle shows diastoles which are typical of mitral stenosis and small abrupt systoles characteristic of mitral insufficiency. Normal variations in the amplitude of the beats are seen. These do not alter the form of the waves and are detected in the middle part of the inferior left arc during the procedures of Valsalva and Müller. In the right lower border there may be seen large auricular waves.

Fig. 7 (*middle, upper*). Kymogram of a 38-year-old individual, with old rheumatic infection, with aneurysmal dilatation of the left auricle, complete arrhythmia and pronounced cardiac insufficiency. Diameters: Valsalva, 17.6; Quiet, 18.2; Müller, 19.2. The left ventricle shows waves of a double mitral lesion which diminish in amplitude during the procedure of Valsalva without modification of their form. During the procedure of Müller they are similarly reduced yet reveal the characteristics of mitral insufficiency. The left auricle, studied in the left median arc, and the superior border of the right auricle show abnormal waves. A large systolic regurgitation may be observed with the opening of the auricular-ventricular valve. This wave of regurgitation is pronounced at rest and reduced in the procedure of Müller and Valsalva. The right auricle does not reveal systolic waves.

Fig. 8 (*lower left*). Kymogram of a 52-year-old man with syphilitic aortic insufficiency and without cardiac insufficiency and a protodiastolic aortic murmur. Heart measurements: Valsalva, 14; Quiet, 16; Müller, 17.6. Waves of protodiastolic regurgitation may be seen in the left ventricle in the procedure of Müller and disappear in the procedure of Valsalva. Also, in the left ventricle the diastole is progressive without characteristic break and the systole lacks isometric periods at rest and during the procedure of Müller. During this latter procedure the amplitude of the ventricular wave is reduced.

Fig. 9 (*middle, lower*). Kymogram of a 40-year-old man with a syphilitic lesion, aortitis, and aortic insufficiency in congestive heart failure. Physical examination revealed a pure protodiastolic aortic murmur. Diameters: Valsalva, 16.3; Quiet, 16.2; Müller, 16.6. The left ventricular waves show full progressive

the waves, "uniform systolic blurring." In one of these cases it was possible to confirm at necropsy the diagnosis made in life. This sign of pericardial effusion is most evident on the left border of the heart during Valsalva's test, and little—if at all—evident during Müller's. In three of these cases the left ventricular volume was not reduced in the Valsalva. In a case in which the left ventricle was small and the right hypertrophied, due to a pulmonary stenosis, the change was much more evident during Müller's test and less during Valsalva's.

Interesting kymographic results were obtained in a case in which there was a full-blown hydatid cyst in the right ventricle, in which there were isolated foci of metastases in the lungs. At the level of the mass, large beats opposite in tune to those of the left ventricle, were observed. It was noted that during Valsalva's procedure the amplitude of the wave did not decrease, despite the decrease of amplitude of the beats of the left ventricle; instead, they appeared larger. On the other hand, with the withdrawal of the left ventricle, during Valsalva's test, the cyst was exposed, while in expansion from Müller's test, the ventricular waves were observed on the outside, and on the inside the cyst waves.

In contrast to this case, there is another in which an immature pericardial hydatid cyst was present. Typical waves of the pulmonary artery were present showing variation in amplitude but not in form of the waves during the procedures of Valsalva and Müller.

In the cases in which there was an interventricular septal defect, congenital in origin, with or without superimposed pulmonary alterations, study of the right ventricle at the apex, and in some cases the inferior right border of the heart, revealed a small expansion, purely systolic, coinciding with the murmur. The expansion decreased or disappeared during Valsalva's test and increased especially during Müller's test. It decreased, disappeared, and increased synchronously with the murmur.

Diverse alterations were observed in the pulmonary arteries in cases of uncomplicated septal defect. Especially a small incisura was noted at the time of termination of ventricular systole which corresponded to the aortic incisura and which was never observed in other cardiac affections, or in those of the pulmonary artery. Another interesting alteration observed in these cases was that the maximal expansion of the pulmonary artery took place at the end of systole. During the tests of Valsalva and Müller the waves varied, taking, during the former, a full and normal shape and during the latter, the beats becoming identical with those normally observed in the aorta.

Alterations of the beats of the pulmonary artery were also noted in other lesions of the pulmonary artery as in one case of double mitral lesion with pulmonary stenosis of possible congenital origin, in which there were observed very full beats in the branches of the pulmonary artery which

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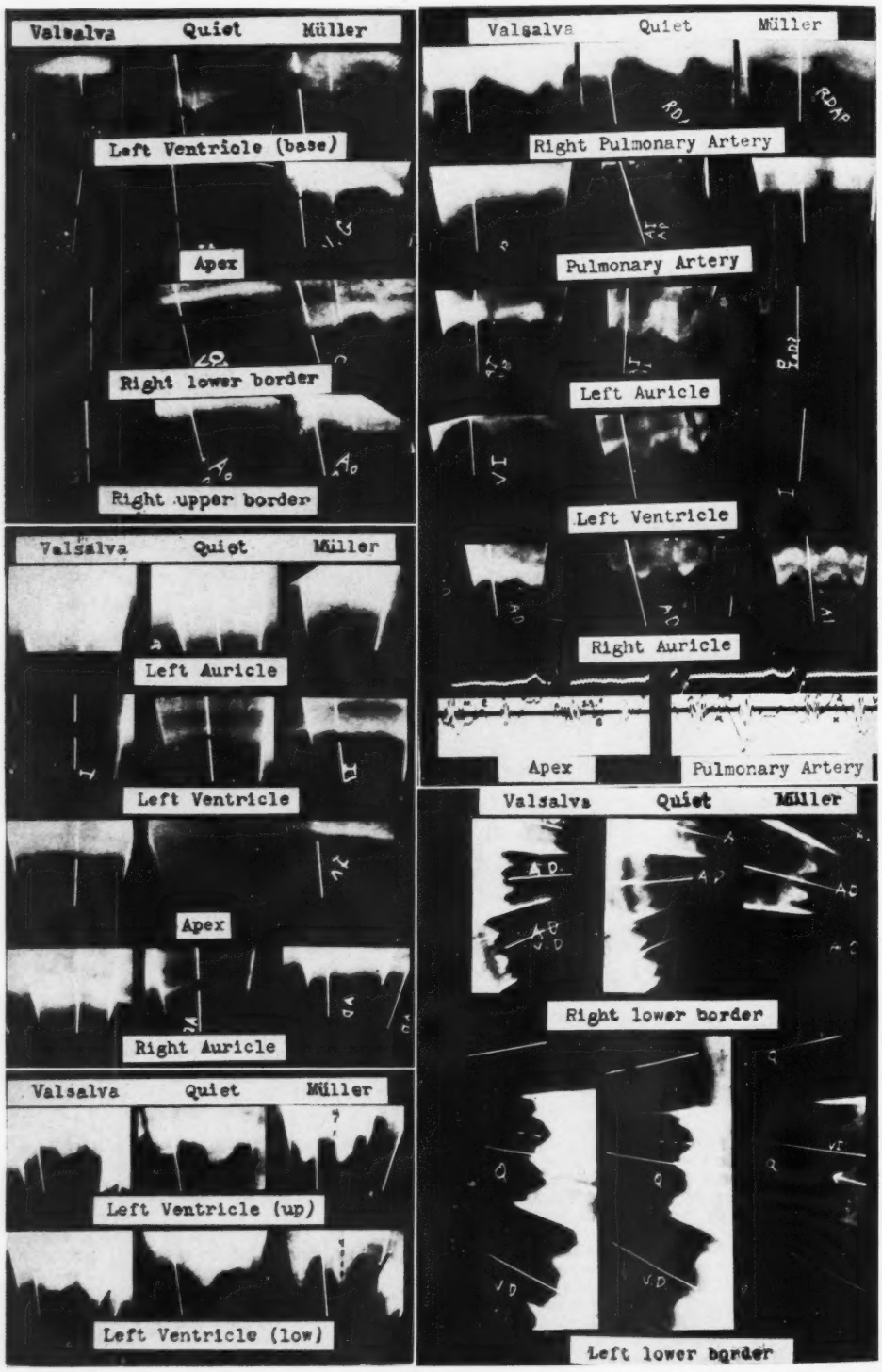
diastole without characteristic break and with small protodiastolic waves of regurgitation and prolonged systole without break. These periods tend to become more normal during the procedure of Valsalva. In the apical area a double curve may be observed radiologically. The appearance of the signs of the uniform systolic disturbances are most apparent in Müller's procedure.

Fig. 10 (*right*). Kymogram of a woman, 32 years of age, with previous rheumatic infection without cardiac insufficiency but with mitral stenosis and aortic insufficiency. Diameters: Valsalva, 10.9; Quiet, 12.4; Müller, 12.8. The systole of the left ventricle is deep and continuous with the expansion that ends with a new systole, but it is interrupted by a gap synchronous with the opening of the mitral valve. This gap almost completely disappears during the procedure of Valsalva, while during the period of Müller it is exaggerated. In rest, the diastolic impulses of the left ventricle are essentially normal but lack isometric periods of systole. During the procedure of Valsalva, the complete diastole at the base shows itself almost exclusively in late diastole, while during the procedure of Müller it is seen principally during early diastole. Systole shows slow and prolonged waves without characteristic breaks. The study of the aorta in the upper margin of the right border reveals typical large waves of aortic insufficiency which are increased in the procedure of Müller and disappear in the Valsalva procedure, being replaced by vena cava waves. The typical wave of the right auricle may be observed, mixed with the ventricular waves at rest, and pure ventricular waves may be observed in the procedure of Müller.


Valsalva
Quiet
Müller
Left Ventricle (base)
Apex
Right lower border
Right upper border
Valsalva
Quiet
Müller
Left Auricle
Left Ventricle
Apex
Right Auricle
Valsalva
Quiet
Müller
Left Ventricle (up)
Left Ventricle (low)
Valsalva
Quiet
Müller
Right Pulmonary Artery
Pulmonary Artery
Left Auricle
Left Ventricle
Right Auricle
Apex
Pulmonary Artery
Valsalva
Quiet
Müller
Right lower border
Left lower border

were markedly dilated, and in the common trunk. Typical waves were observed with small midsystolic shock which cut short the systolic expansion of the artery, and which corresponded to a systolic thrill or systolic pseudo-gallop, audible at that level. This shock disappeared synchronously with gallop, both in Valsalva's test and in Müller's.

In a case of uncomplicated congenital pulmonary stenosis, it was observed that the beats were of the aortic type. They increased in amplitude during Valsalva's test and decreased during Müller's test. Before the beginning of the expansion there was a sudden, deep incisura which did not correspond to any auditory phenomenon and which did not disappear during the tests of Valsalva and Müller, in spite of variations in the amplitude of the beats.

DISCUSSION

The study of the variations of the transverse diameter of the heart after the procedures show us that whenever the post-systolic volume is increased or there is a greater stretching than normal of the myocardial fibers, the Valsalva test produces a greater diminution in the transverse diameter than in the normal.

This change occurs in the left ventricle in well compensated mitral insufficiency, where it seems illogical to admit the existence of residual blood, since at the instant of systole the blood leaves the ventricle through the insufficient mitral valve in addition to the normal or aortic route. But a consideration of the post-systolic residue according to Bohm's criteria (7), the assumption that it may in reality be the sum of a small ventricular residue plus

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Fig. 11 (*upper left*). Kymogram of a 60-year-old man with hypertension, arteriosclerosis, and good compensation. Murmurs were detected in the band of Huchard. Diameters: Valsalva, 16.8; Quiet, 18.3; Müller, 18.8. Ventricular waves, with much prolonged diastole and systole resembling tidal waves, may be observed. The amplitude diminishes normally in the procedure of Valsalva and is accentuated in the procedure of Müller.

Fig. 12 (*upper right*). Kymogram of a 48-year-old man with a congenital heart lesion diagnosed as pulmonary stenosis with a double mitral lesion. Examination revealed moderate cyanosis and good cardiac sufficiency. Diameters: Valsalva, 19; Quiet, 19.4; Müller, 20. In the branches of the pulmonary artery large waves may be observed which show little increase during the procedure of Müller and are reduced without modification of their form during the procedure of Valsalva. While in the common pulmonary trunk a deformed wave is observed at a point which corresponds to the instant at which a systolic snap was detected at this level. A notch is also seen which disappears during the course of the procedure and increases in amplitude during the procedure of Valsalva but is reduced in the procedure of Müller. The left ventricle exhibits typical diastolic waves of mitral insufficiency in spite of the exhibition of rounding at the apex and its behavior in the procedures of Valsalva and Müller as if it were a pure insufficiency. The right auricle exhibits ventricular waves during the procedure of Müller.

Fig. 13 (*left, middle*). Kymogram of a young girl, 16 years of age, with multivalvular rheumatic heart lesions and who had shown some improvement with treatment. Diameters: Valsalva, 14.3; Quiet, 14.5; Müller, 14.4. In all the procedures there may be observed waves with characters which are reduced in amplitude during the procedure of Valsalva and Müller, with the exception of the right auricle which is increased during the former.

Fig. 14 (*left, bottom*). Kymogram of a 40-year-old man who experienced no subjective or objective cardiac symptoms but who, on general physical examination, revealed two small tumors of from two to three centimeters located in the pericardium against the anterior and external portion of the communicating trunk of the pulmonary artery and in the inferior and external portion of the left branch. These are projected in the frontal position in the middle and superior portion of the left inferior arc and have waves opposite in time to the ventricle. This was interpreted as being due to a small hydatiform cyst of the pericardium because of existing eosinophilia. Diameters: Valsalva, 13.5; Quiet, 15.1; Müller, 15.5. The pulsations of the small tumor at the middle possess the qualities described by Wiggers in the pulmonary artery, and in the execution of the procedure of Valsalva and Müller they are reduced and are increased at the same time as the amplitude of the ventricular waves. Their form is not modified but they continue to terminate their expansion much before the onset of systole.

Fig. 15 (*right, bottom*). Kymogram of a young man with multiple pulmonary hydatids following the rupture of a hydatid cyst in the right ventricle. No cysts were found peripherally. Diameters: Valsalva, 12.2; Quiet, 12.7; Müller, 13.8. There was observed in the anterior surface of the heart and projecting into the region of the middle part of the inferior arc a mass with pulsations opposite to those of the ventricle whose expansion begins with the systolic retraction of the ventricle and reaches its maximal expansion at the end of systole. It terminates its retraction with the onset of the new systole. During the procedure of Müller the volume of the left ventricle is increased, revealing its waves imposed upon those of the mass and increasing the amplitude of both. The waves produced by the cyst are ample and sharp. During the procedure of Valsalva, the left ventricular waves are reduced, disclosing the cyst which presents typical plethoric waves.

an auricular residue, explains this apparently illogical situation.

According to this author, the auricular-ventricular septum plays a very special rôle during systole and diastole. Its movement is more marked than that of the ventricular wall; and this whole septum is really nothing more than the auricular-ventricular valve which remains relatively closed during systole and opens almost instantly as soon as diastole begins. An isometric diastolic period does not exist, for all the blood which has accumulated in the auricle empties into the ventricles, the blood being admitted *via* the pulmonary veins to the auricle and thence ejected to the ventricles through the insufficient mitral valve.

The ventricular filling is almost instantaneous, as demonstrated by the rapidity with which diastole is accomplished in these cases. In this way the ventricle is in a position to fulfill Starling's law. It is possible that the muscular fibers are much stretched so that when systole occurs the contraction is very powerful, as Wiggers has demonstrated (9).

This post-systolic residue is really not ventricular, but is auricular-ventricular, as Bordet and Fischgold (4) point out. This residue forms the contour of the systolic ventricular border in the lateral walls of the left ventricle. Bordet and Fischgold also stress the fact that if we desire to isolate the true ventricular post-systolic residue, we must visualize the movement of the auricular-ventricular septum rather than study the lateral contour of the ventricle.

The action of this ventricle on the large post-systolic residue, in which only a very small increase in the transverse diameter is observed in the Müller test, can be explained in Bohm's opinion as follows: When the filling of the ventricle is facilitated by the increase in negative intrathoracic pressure as in the Müller test, there is no change in size, inasmuch as at the beginning of diastole the blood which descends from the auricle in a way hastens ventricular diastole, filling the ventricle completely. In other words, in incompetence of the mitral valve, the auricular pressure is so high that the change produced by the Müller test is insufficient to affect the inflow into the ventricle.

If mitral stenosis is superimposed on the insufficiency, or if a difficulty in passage of blood from auricle to ventricle exists, the equilibrium is upset; or, better still, the unity of the post-systolic auricular and ventricular residues is destroyed. In the first case both are functionally the same; now each one has its individuality. In that case a reduction of the transverse diameter during the Valsalva test is not observed inasmuch as the ventricle itself forms a small post-systolic volume in spite of the fact that the auricular residue may be great.

In those cases in which the equilibrium of the residue has been broken, there is a great wave of systolic reflux at the level of the contour of the left auricle similar to that which is observed in the right auricle in tricuspid insufficiency with venous hypertension. This phenomenon is also observed in the mitral insufficiencies with cardiac insufficiency which provokes an increase in the pressure within the left auricle, not through stenosis or insufficiency of the orifice, but through a residue from the left ventricle incapable of expelling all the blood which the pulmonary circulation sends to it.

This equilibrium can also be broken by a different mechanism when the auricle fibrillates. In such a case there is no systole of the auricle; then the physiological emptying is not very great, it is sufficient to break the equilibrium of the auricular pressure, and if auricular hypertension appears, a wave of reflux can be visualized which may end just at the moment of opening of auricular-ventricular valves.

The waves of systolic reflux in the auricles were observed only in those cases in which an imbalance existed between the post-systolic residues; therefore, there may exist an insufficiency of the left heart due to a difficulty in the passage of blood from the auricle to the ventricle, or to an

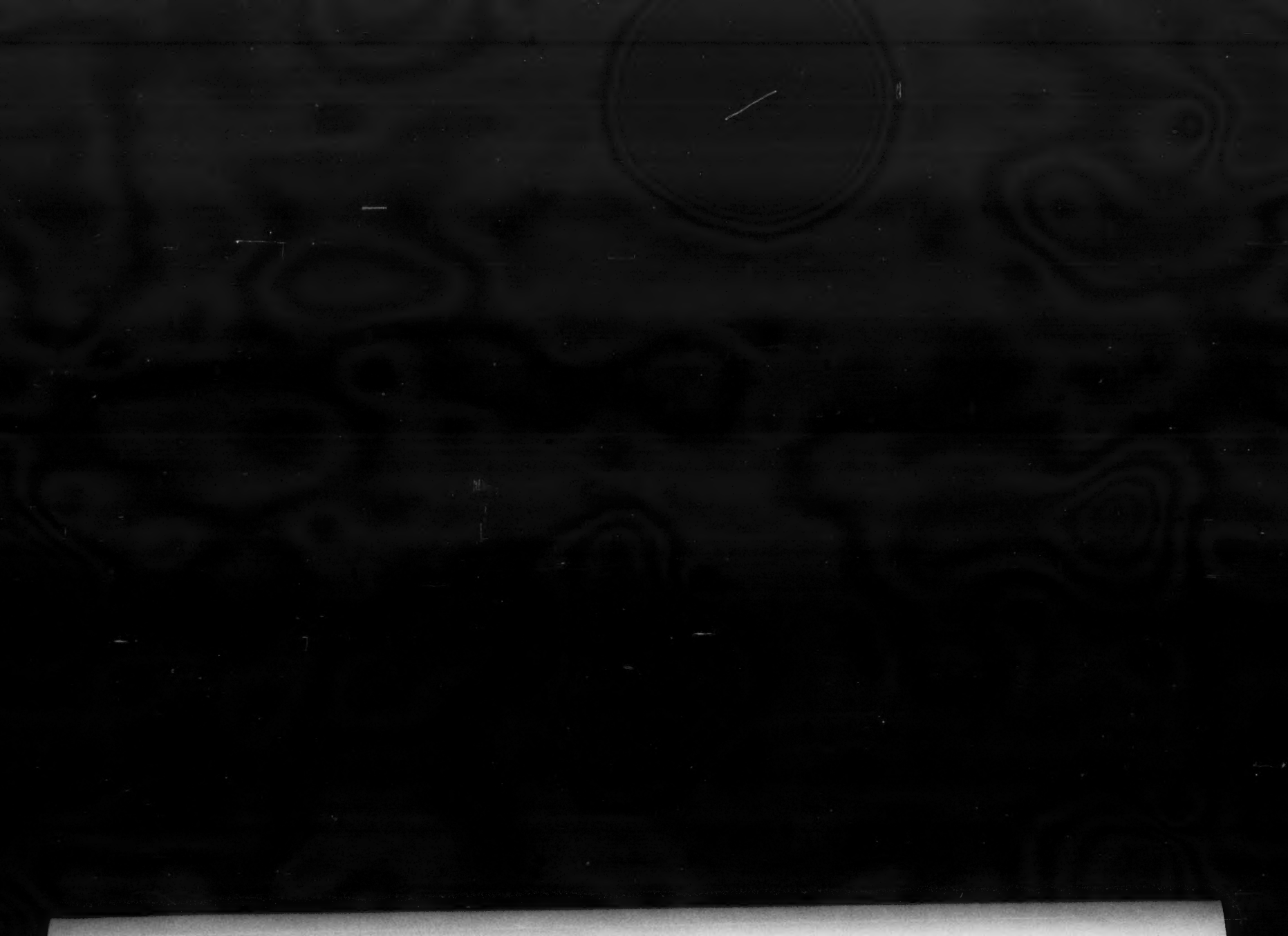

TABLE I.—ALTERATIONS OBSERVE

No.	Case	Sex	Age	Etiology					Card. Suff.	Horizontal Diameter			Alterations Observed in Form of Waves			
				C	R	S	Ar	O		Val-salva	Quiet	Müller	Valsalva	Quiet	Müller	Sn
1	Normal	m	18						G	11.2	12.8	13.4	l.n	n	g.n	.....
2	Mitral stenosis	m	32		x				F	15.1	16.8	16.2	M.S.	M.S.	n	.....
3	Mitral insufficiency	m	24		x				F	12	14	15.6	n	M.I.	M.I.	.....
4	Mitral insufficiency	m	27		x				B	13	15.1	15.1	M.I.	M.I.	M.I.s.p.	.....
5	Mitral insufficiency	f	25		x	x			A	17	18.5		M.I.	M.I.		.....
6	Mitral stenosis and insufficiency	f	20		x				G	18.8	18.9	19.3	d:M.S. s:M.I.	d:M.S. s:M.I.	d:M.S. s:M.I.	.....
7	Mitral stenosis and insufficiency	m	38		x				F	17.6	18.2	19.2	idem	idem	I.M.	.....
8	Aortic insufficiency	m	52			x			G	14	16	17.6	n	Ao.I.	Ao.I.	.....
9	Aortic insufficiency	m	40			x			A	16.3	16.2	16.6	Ao.I.	Ao.I.	Ao.I.	.....
10	Mitral stenosis and aortic insufficiency	f	32		x				G	10.9	12.4	12.8	M.S.	n	M.I.	.....
11	Mitral insufficiency and aortic stenosis	m	60				x		G	16.8	18.3	18.8	l.waves	waves	g.waves	.....
12	Pulmonary stenosis and mitral stenosis and insufficiency	m	48	x	x				G	19	19.4	20	M.I.	M.I.	M.I.	Pulmo Syst
13	Combined valvular disease	f	16		x				A	14.3	14.5	14.4	l.waves	waves	l.waves	.....
14	Hydatid cysts of pericardium	m	40					x	G	13.5	15.1	15.5	l.n	n	g.n	.....
15	Hydatid cysts open in the right ventricle	m	28					x	F	12.2	12.7	13.8	l.n	n	g.n	.....
16	Aneurysm formation after cardiac infarction	m	55				x		G	14.7	15.7	17.5	waves	w-Ex.s.	w-Ex.s.	.....
17	Aneurysm formation after cardiac infarction	f	51			x			A	11.5	13.8	14.8	l.Ex.s	Ex.s.	g.Ex.s.	.....
18	Myocardial disease	f	38					x	A	12.7	13.7		W	W		.....
19	Pulmonary stenosis	f	26	x					G	10.7	11	11.2	a	n	a	.....
20	Pulmonary stenosis	m	25	x					B	16.2	16.4	16.5	...	...	...	.....
21	Interventricular septal defect and isolated dextrocardia	f	25	x					B	15.2	16		l:W	W		.....
22	Interventricular septal defect and pulmonary stenosis	f	33	x					G	14.8	15	14.8	l:W	W	g:W	.....
23	Pericardial disease and mitral insufficiency	f	26		x				F		12	12.8		M.I.	M.I.	Left Sys
24	Pericardial disease and chronic tuberculosis	f	27					x	F	11.8	12	13	n	n	n	.....
25	Pericardial disease (rheumatic)	f	29		x				B	14.2	15.2		...	...		.....

x. = Yes.
G. = Good cardiac sufficiency.
F. = Fair cardiac sufficiency.
B. = Bad cardiac sufficiency.
A. = Asystolie (Lian).
n. = Waves of normal form.
M.I. = Mitral insufficiency waves.
C. = Congenital
R. = Rheumatic
S. = Syphilitic
Ar. = Arteriosclerotic
O. = Other
M.S. = Mitral stenosis waves.
Ao.I. = Aortic insufficiency waves.
w. = Waves without periods.
Ex.s. = Systolic expansion.
a. = Absent.
lb. = Left border.
rb. = Right border.
ap. = Apex.
l. = Little.
g. = Great.
AVV. = Opening of the auriculo-ventricular valves.
fib.t. = Fibrillation type.
amp. = Amplitude.
M>Q>V = Müller greater than Quiet, and Quiet greater than Valsa
S. ref. = Systolic reflux.

TABLE I.—ALTERATIONS OBSERVED IN SOME CARDIAC DISEASES

al Diameter		Alterations Observed in Form of Waves			Pericardial Alterations					
Quiet	Müller	Valsalva	Quiet	Müller	Snaps.	Syst. Con.	Adhes. P.	Double Contour	Syst. Ref.	Sy
12.8	13.4	l.n	n	g.n	.....	.....	..	.....	...	
16.8	16.2	M.S.	M.S.	n	.....	.....	..	.....	...	
14	15.6	n	M.I.	M.I.	.....	.....	..	.....	...	
15.1	15.1	M.I.	M.I.	M.I.s.p.	.....	.....	..	.....	...	
18.5		M.I.	M.I.		.....	.....	..	.....	Q>M	
18.9	19.3	d:M.S. s:M.I.	d:M.S. s:M.I.	d:M.S. s:M.I.	.....	.....	..	.....	M>Q	
18.2	19.2	idem	idem	I.M.	.....	.....	..	.....	...	
16	17.6	n	Ao.I.	Ao.I.	.....	.....	..	.....	...	
16.2	16.6	Ao.I.	Ao.I.	Ao.I.	.....	lb.M>Q>V	..	lb.V>Q>M	...	
12.4	12.8	M.S.	n	M.I.	.....	.....	..	.....	...	
18.3	18.8	l.waves	waves	g.waves	.....	.....	..	.....	...	
19.4	20	M.I.	M.I.	M.I.	Pulmonary Art. Systolic	.....	..	.....	...	
14.5	14.4	l.waves	waves	l.waves	.....	.....	..	.....	...	
15.1	15.5	l.n	n	g.n	.....	.....	..	.....	...	
12.7	13.8	l.n	n	g.n	.....	.....	..	.....	...	
15.7	17.5	waves	w-Ex.s.	w-Ex.s.	.....	.....	x	.....	...	
13.8	14.8	l.Ex.s	Ex.s.	g.Ex.s.	.....	.....	..	.....	...	
13.7		W	W		.....	.....	..	.....	...	
11	11.2	a	n	a	.....	.....	..	.....	...	
16.4	16.5	...	...	...	.....	lb.M>Q>V rb.V>Q>M	..	lb.M>Q>V rb.V>Q>M	...	
16		l:W	W		.....	.....	..	.....	...	
15	14.8	l:W	W	g:W	.....	.....	..	.....	...	
12	12.8		M.I.	M.I.	Left Ventr. Systolic	.....	x	.....	M>Q	
12	13	n	n	n	.....	ap.V>Q>M	..	ap.V>Q>M	...	
15.2		...	...		.....	lb.V>Q	..	lb.V>Q	...	

Right border.
Apex.
Little.
Great.
Opening of the auriculo-ventricular valves.
Fibrillation type.
Amplitude.
Müller greater than Quiet, and Quiet greater than Valsalva.
Systolic reflux.

Left Auricle				Right Auricle	Apex	Right Lower Border		
Syst. Ref.	Syst.	Ap.AVV.	Vent. t.			Syst. Ref.	Vent. t.	Auric. t.
...	n	n	.....	n	.....	...	M>Q>V	.....
...	n	n	M	.....	Q>V>M	...	M>Q>V	.....
...	..	g	M>Q>V		Q>V>M	...		
...	n	g	Mx Q>V					
Q>M	n	n	.....	Syst. ref.	.....	...		
M>Q	n	n	.....	g	V>Q	...		x
...	..	.....	x	AVV-Q>V>M	Q>V>M	...	.....	fib. t.
...					d.c.			
...	n	M>Q>V	.....	M-Vent. t.	Q>V>M			
...	n	M>Q>V	.....	Q>y>V	Q>V>M	...	M>Q	V
...					M>Q>V	...	M>Q>V	.....
						...		
...	n	n	.....	M>Q>V				
...	w	w	.....	AVV-Q>V>M	.....			
...								M>Q>V
...								
					amp.V>M>Q ref. M>Q			
...					M> Q>V			
...	n	n	.....	n				
...	n	n	.....	alt.				
...					V> Q>M			
...				M				
					amp. Q>V			
...				alt.	s.ref. Q>V	Q >V		
				n				
...					amp.M>Q>V			
M>Q					s.ref.M>Q>V	M>Q		
...				n	alt.			
...					alt.			

auricular fibrillation which makes the evacuation difficult. The expansive systolic wave of the auricle increased during Müller's test and decreased during Valsalva's. This at first glance appears illogical, considering that during the first test the intraplural pressure is less, and for that reason less blood leaves the pulmonary veins. But during that test a secondary alteration exists, which is the increase in amplitude of the beats of the ventricle upon increasing its post-systolic capacity; and, for that reason its muscular fibers are more distended, fulfilling Starling's law with a greater contractile energy. This increase in myocardial energy will result in an increased systolic pressure, and therefore, an increase in reflux through the auricular-ventricular valve; to this is added a poorer adaptation of the valves, inasmuch as the increase in volume of the ventricular cavity stretches the pillars, and the approximation of the valves is inadequate. During Valsalva's test this reflux disappears by a reverse mechanism.

The reduction of the transverse diameter in the Valsalva in old myocardial infarcts is still greater than in pure mitral insufficiency. The same condition occurs in those cases of myocardial degeneration in which there is no change in the cardiac silhouette suggestive of cardiac aneurysm. I believe this phenomenon may be explained on the basis that during ventricular systole the expulsion of the blood cannot be what it is normally, because, in cases in which there exists a zone of altered contractility, at the end of systole there is a residue of blood equal to the blood which has not been mobilized due to the defect in contraction (secondary to the infarct zone).

During the Valsalva test, an external expulsion of the previously mentioned pathological residue is effective. The new diastole finds this region free, and systole impels the blood inside the ventricle in the direction of the aortic valve, without meeting an inert mass of blood in the affected region. The blood, therefore, passes without obstacle from the ventricle to the aorta. If a small residue is present, this blood will collide with it, and variable interference follows.

During Müller's test, this residue will be artificially increased instead of having been annulled as in Valsalva's test. At the beginning of systole, the blood in the region of the apex is set in violent motion colliding with the inert mass, resulting in a collision between the mass in motion and the inert mass of blood. The contour of the heart at this level in the kymogram shows a great systolic expansion of short duration. This expansion is only the representation of the radiated distribution of the force set free by the impact of blood in motion with blood at rest.

This zone generally is found in the medial part of the left border of the left ventricle, many of these patients showing E. K. G.'s of the T1 or T3 type.

If we were dealing with true aneurysms of the ventricle, we should observe at this level, an expansion which would begin at systole, reaching its maximal point at the instant at which the aortic leaflets open. This expansion would decrease slowly until the instant when rapid ejection ends completely at the end of systole. Or it would show a curve resembling that of the interventricular pressure. No case even in the Müller test when the phenomenon is almost always more evident, was observed.

This explains why it is indispensable to put patients who have recently suffered a myocardial infarction on a low food intake with complete rest.

In this way, the post-systolic residue is reduced, this residue being the direct cause of the impact which the ventricle suffers upon initiating the movement of the mass of blood in its cavity. This violence damages the infarcted wall and should be prevented, bearing in mind that not only the impact in relation to the intensity of the contractile energy set free, but also the importance of the residue.

The great increase in the transverse diameter during Müller's test in the patients with aortic stenosis or insufficiency with cardiac insufficiency, illustrates the parallelism between this phenomenon (that

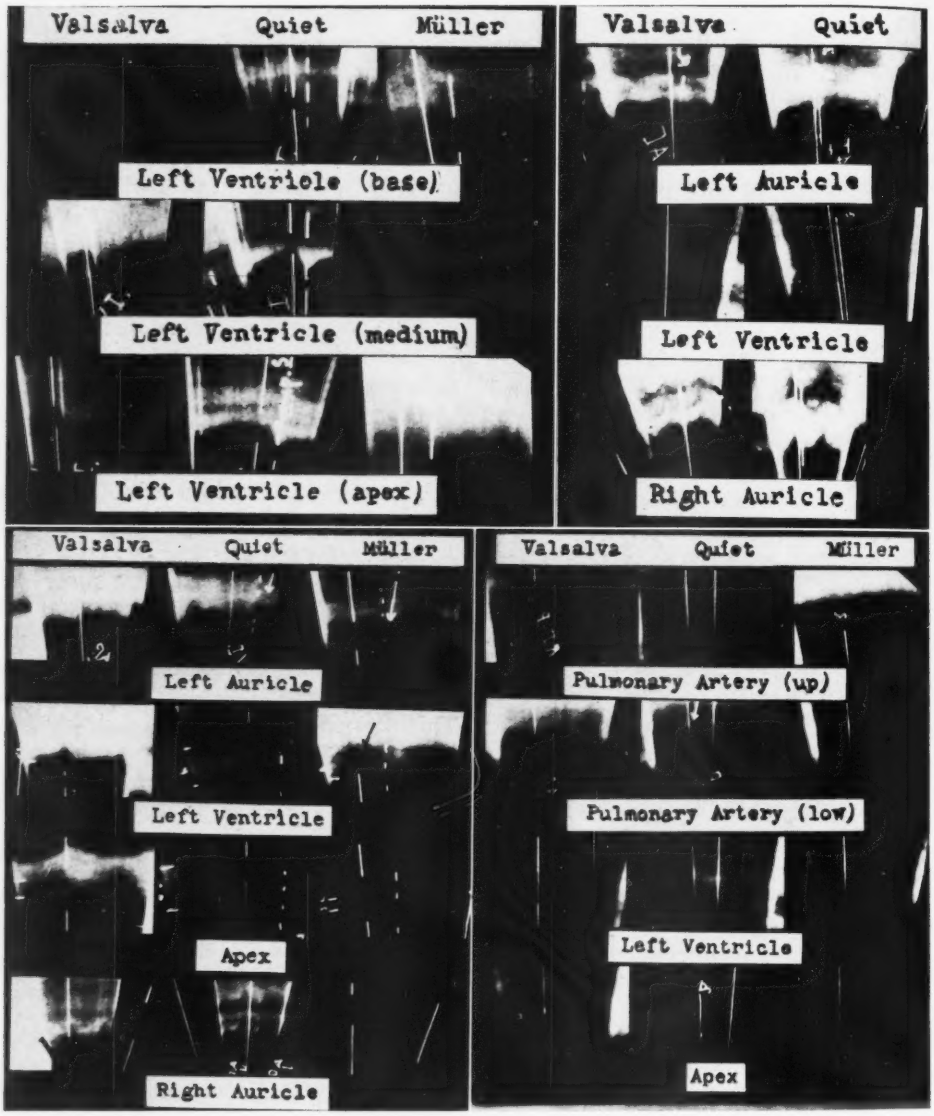

Fig. 16 (*upper left*). Kymogram of a 55-year-old man who sustained an infarct of the myocardium five months before. This was proved clinically and by the electrocardiogram. The E.K.G. reveals, in lead III an enlarged Q wave, inverted T wave, and in lead IV, absence of a Q wave. Diameters: Valsalva, 14.7; Quiet, 15.7; Müller, 17.5. In the inferior part of superapical region of the left inferior arc, in the frontal position, there may be observed a zone of thickening (adhesive pericarditis) with altered waves showing a sharp and short expansion. These are reduced with the protosystolic retraction and disappear completely during the procedure of Valsalva. They are larger and longer during the procedure of Müller.

Fig. 17 (*lower left*). Kymogram of a 51-year-old syphilitic woman who suffered from angina and had a left ventricular gallop, a protodiastolic murmur of the aorta, and fusiform aneurysmal dilatation of the aorta. The E.K.G. reveals a PR interval of 0.23 second and inverted P wave in leads I and II. Diameters: Valsalva, 11.5; Quiet, 13.8; Müller, 14.8. The waves of the left ventricle are very large at the apex and show an abnormal diastolic convexity. Their amplitude is reduced without altering their shape during the procedure of Valsalva, while, during the procedure of Müller, the diastole shows rapid filling characteristic of mitral insufficiency. In the middle and superior portion of the inferior left arc there may be observed a brisk, short expansion during protosystole which almost disappears during the procedure of Valsalva and reduces with appearance of a normal diastolic element during the procedure of Müller.

at first glance appears illogical in hearts which are large) and the unsuspected capacity of the force which is characteristic of them. These are patients with a ventricular hypertrophy compensating valvular lesion, which have an almost normal reserve sufficient to satisfy a transitory demand for more contractile energy.

But not all the cardiopathies can adapt themselves in such a manner to the modification of the intrathoracic pressure: mitral stenosis, mitral insufficiency and mitral stenosis, aortic and pulmonary stenosis, and the multivalvular cardiopathies do it in a very poor way. It can be shown that all those lesions which delay the flow of blood to the heart, impede passage from one cavity to another, or greatly impede the exit of blood to the great or small circulation result in a degeneration of the ventricular muscle. If the transverse diameter is but little changed these patients have a good prognosis; except that always they are unable to do any appreciable work without showing dyspnea.

Contrary to what would appear at first glance, the variations in shape of the waves of the left ventricle during the tests of Valsalva and Müller are not very great, and are in reality (in almost all cases) variations similar to those observed in normal waves which can simulate characteristic pathological alterations, as Hirsch (3) has noted.

Great alterations in shape were observed only in those cases in which there was a post-systolic plethora as in decompensated mitral insufficiency, aortic insufficiency, or mitral stenosis showing in the Valsalva test a decrease in aortic reflux due to lower pressure in the vessel. The diastoles are more typical in mitral stenosis associated with other lesion, but the amplitude becomes abnormally great due to the hypertension developed in the auricle when the blood of the lung is impelled toward it. During Müller's test, the ventricle increases the aortic pressure and, therefore, the aortic reflux becomes more evident; and on the other hand, upon dilatation of the heart, the passage of blood during diastole through the auricular-ventricular valves occurs with greater ease because there is no blood in the cavity when it reaches there. This diastole of mitral insufficiency is nothing more than the exaggeration of a normal phenomenon in a pathological state.

The normalization of diastole during Valsalva's test, in the well compensated case of mitral insufficiency, is explained by the increase in intrathoracic pressure which compresses the heart, reducing its diastolic volume by which the muscular pillars which were stretched impeded the closing of the valves, now permits them to close.

In cases of communication between both ventricles due to a congenital anomaly, one observes in the right ventricle a short dilatation in the first instant of systole which always ends before diastole. I attribute this dilatation to the impact of the stream of blood which passes through the septal orifice and then crosses the ventricular cavity to the wall. This dilatation ought not to be confused with the dilatation proper of the right auricle in the middle and at the end of the systole due to physiological filling of the same, inasmuch as this expansion always ends before the end of systole, while the true auricular wave ends just at the moment of opening of the

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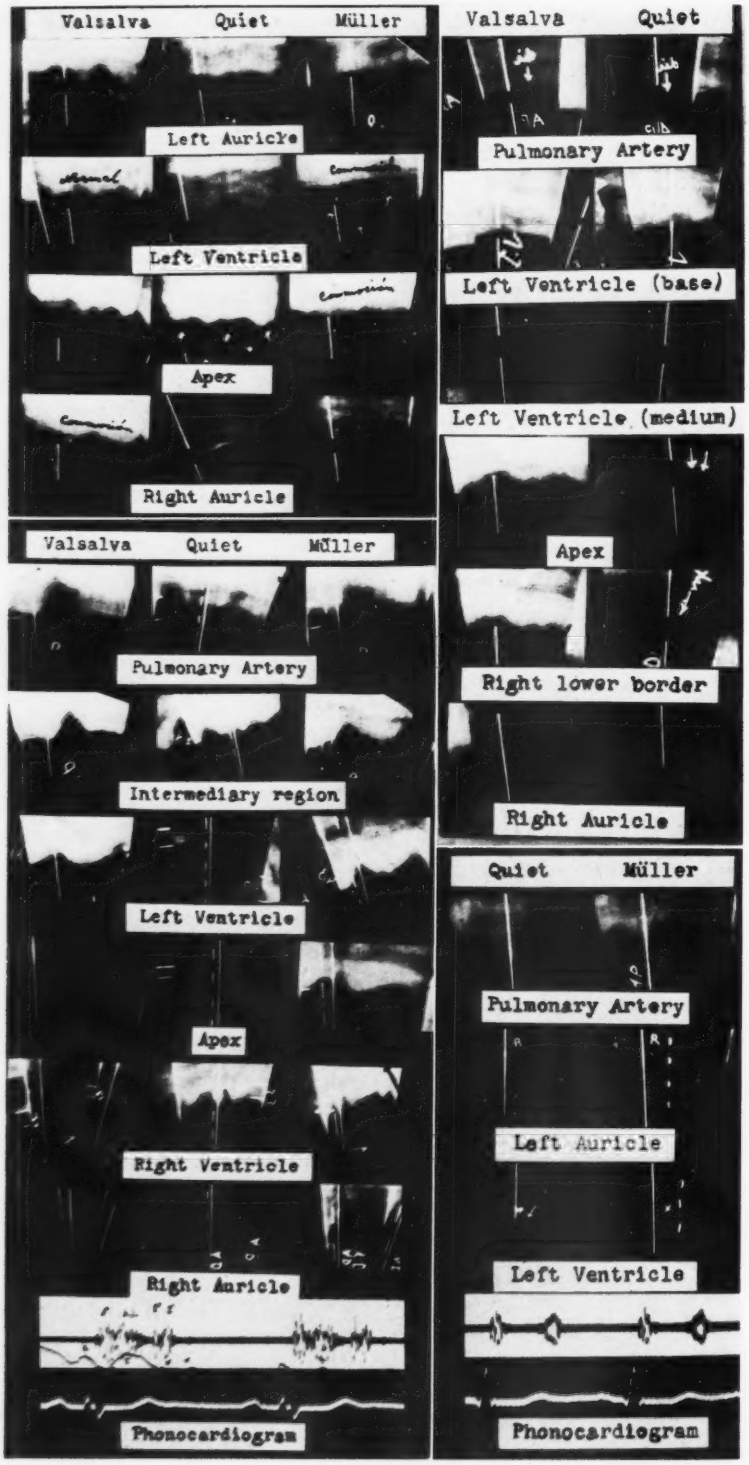
Fig. 18 (*upper right*). Kymogram of a 38-year-old woman with cardiac insufficiency who had suffered from nephritic hypertension for 19 years. She had had attacks of pulmonary edema and succumbed, six days following this examination, to progressive cardiac insufficiency. Diameters: Valsalva, 12.7; Quiet, 13.7. The waves of the left ventricle are altered most. The diastolic limbs are shorter than systole, due to the very large systolic and diastolic isometric period. A reduced amplitude of the wave was not observed, in spite of a substantial reduction of the horizontal diameter of the heart.

Fig. 19 (*lower right*). Kymogram of a 26-year-old woman with congenital pulmonary stenosis and typical cyanosis but without cardiac insufficiency. Diameters: Valsalva, 10.7; Quiet, 11; Müller, 11.2. In the lower part of the common pulmonary trunk there may be observed waves of vascular pattern which begin with a short deep incisura which is increased in amplitude during the procedure of Valsalva and is reduced during the procedure of Müller. It is synchronous with the apical waves, those of the inferior right border, but not with those of the left ventricle.


Valsalva
Quiet
Müller
Left Auricle
Left Ventricle
Apex
Right Auricle
Valsalva
Quiet
Pulmonary Artery
Left Ventricle (base)
Left Ventricle (medium)
Apex
Right lower border
Right Auricle
Valsalva
Quiet
Müller
Pulmonary Artery
Intermediary region
Left Ventricle
Apex
Right Ventricle
Right Auricle
Phonocardiogram
Quiet
Müller
Pulmonary Artery
Left Auricle
Left Ventricle
Phonocardiogram

auricular-ventricular valves, or in diastole. In confirmation of this I ought to mention that, moreover, the reflux is observed at the apex of the heart, which negatives completely its auricular nature.

In a case in which pulmonary stenosis was superimposed, there was observed in the waves at the systole, an incisura similar to the aortic incisura. It is interesting to note that I have never observed this alteration in the numerous cases of diverse congenital or acquired affections of the artery which I have had occasion to study, and in which no communication existed between the ventricles.

It seems as if this notch and the aortic notch are exactly the same phenomenon. The action of Valsalva's test upon the wave of reflux in the intraventricular communication is very obvious inasmuch as it tends to prevent it by increasing the pressure in the right ventricle, increasing the resistance of the pulmonary circulation, and decreasing the pressure in the left ventricle. During Müller's test this wave of reflux increases enormously as a result of the fall in pressure in the right ventricle through the decrease of the resistance in the pulmonary circulation, and the pressure in the left ventricle increases as a result of the increase in the amplitude of its waves, and the absence of variation in the resistance in the general circulation. In all these cases, the characteristic murmur is diminished, parallel with the amplitude of the wave of reflux during Valsalva's test, and the murmur is increased during Müller's.

In a case in which there existed an accessory cavity in communication with the cardiac cavities, it was possible to observe the characteristics of these cavities, as when a hydatid cyst opened into the right ventricle. The pulsations of the cavity were opposite in time to those of the left ventricle. It expanded until the end of systole and contracted rapidly until the end of diastole.

Upon studying Valsalva's and Müller's tests, it was observed that during the former, the left ventricle, upon decreasing in volume, receded, leaving the cavity which showed full amplitude of the waves. During Müller's test, the left ventricle increased in volume, sailed past the cavity,

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Fig. 20 (*upper left*). Kymogram of a 25-year-old man with congenital pulmonary stenosis with typical cyanosis and in moderate congestive failure. Diameters: Valsalva, 16.2; Quiet, 16.4; Müller, 16.5. The left ventricular waves are much more marked during the procedure of Valsalva and are reduced to normal in the procedure of Müller. In the middle portion of the inferior left arc and at the apex, there is a double outline opposite high waves with characteristic uniform systolic blurring movement. These are seen at rest in the procedure of Müller, while at the right border of the heart the waves are normal and high in the procedure of Müller and altered in the procedure of Valsalva.

Fig. 21 (*upper right*). Kymogram of a 25-year-old woman with a congenital heart lesion diagnosed during life as a patent interventricular septum with reversal of blood flow. She died three months afterward of a complicating endocarditis and the clinical diagnosis was confirmed at necropsy. Diameters: Valsalva, 15.2; Quiet, 16.4; Müller, 16.5. The waves of the left ventricle lack the normal appearance during the procedure of Valsalva and are reduced in amplitude. At the apex and lower border on the right side of the heart shadow, a protosystolic expansion may be observed which is reduced in amplitude and duration during the procedure of Valsalva. The pulmonary artery shows great alteration of its waves with maximum expansion telesystolic. An incisura may be observed which corresponds to the end of systole. At the level of the right auricle no wave may be observed.

Fig. 22 (*lower left*). Kymogram of a 33-year-old woman diagnosed as a congenital cardiac with patent interventricular septum and pulmonary stenosis without cardiac insufficiency but with slight cyanosis. Diameters: Valsalva, 14.8; Quiet, 15; Müller, 14.8. The kymograph reveals apical waves with mid-systolic expansion which disappear in consonance with the murmur during the procedure of Valsalva and are increased during the procedure of Müller. The waves of the pulmonary artery are greater than those of the aorta. This is increased during the procedure of Valsalva, while during the procedure of Müller the arterial expansion begins with a slow protodiastolic ascent which is broken up by a brisk mesosystolic expansion of a wave which is equal to that observed at rest (the sign of a patent ductus Bottali).

Fig. 23 (*lower right*). Kymogram of a 26-year-old woman who had suffered for the past three years from polyarticular rheumatism. She was well treated and presented from the first a musical telesystolic murmur which was small and harsh and located at the apex. Actually, in the radiographs, there may be observed many calcified pericardial plaques. Diameters: Quiet, 12; Müller, 12.8. The kymogram reveals left ventricular waves with a large systolic wave of reflux and the pulmonary artery is of the congestive type. The waves of the left ventricle are typical of mitral insufficiency in diastole. In systole, they are interrupted by a variation which corresponds to the onset of the musical murmur and ends with the completion of the expansion of the reflux auricular wave. This variation is most conspicuous during the procedure of Müller.

and increased the amplitude of its waves in a normal way. This was not the case with the waves of the accessory cavity which became ample and water hammer. I believe that the water hammer character may be due to the decrease in the resistance of the small circulation during Müller's test, in the same way that the pulse becomes irregular in peripheral circulatory insufficiencies; and they are increased owing to the increase of the amplitude of the right ventricular pulse during Müller's test.

If the cavity had been in contact with and had opened into the left ventricle, its beats would have been modified in the same manner as are the aortic beats during the test, decreasing its amplitude during Valsalva's test and increasing it during Müller's test.

Finally, if the cavity were in contact with neither cardiac cavity, as was observed in another case, it would transmit the beats of the chamber upon which it was located, without deforming them, varying in the same way that the waves varied during the tests.

The study of the small pericardial effusion showed the existence of the phenomenon of the uniform systolic vibratory movement on the left border, together with this double contour. The phenomenon of uni-

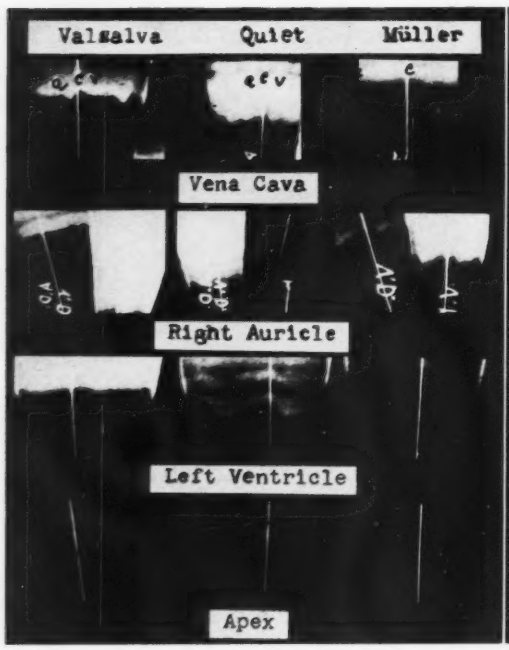

Fig. 24.

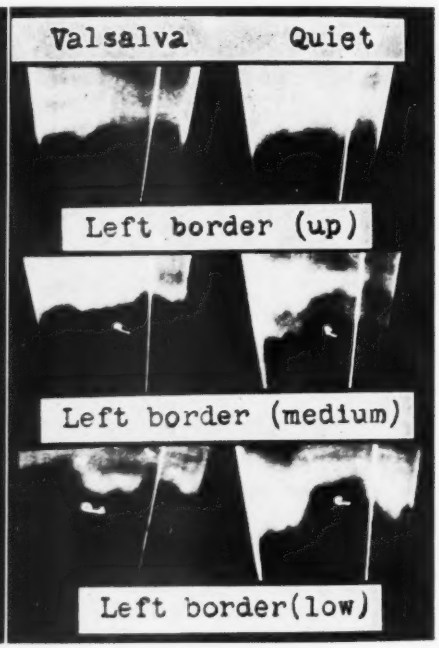

Fig. 25.

Fig. 24. Kymogram of a 27-year-old woman who suffered from extrasystoles, dyspnea on exertion, and arterial hypertension, but who was completely negative on physical examination with the exception that a slight pericardial effusion was suspected radiologically by the existence of a double contour through the inferior left arc. This was most marked at the apex and at the base of the heart. She responded to antibacillary treatment and obtained complete cure but the changes persisted. Diameters: Valsalva, 11.8; Quiet, 12; Müller, 13. The sign of the "uniform systolic blurring" was present at the point altered by the maximum systolic expansion. This is lessened and almost disappears during the procedure of Müller and is accentuated during the procedure of Valsalva. In the upper portion of the right contour of the heart, the waves of the vena cava may be observed with the waves showing very prominently at rest and even more so during the procedure of Valsalva. The accentuation of the waves may be observed principally in the auricle and ventricle in the procedure of Müller.

Fig. 25. Kymogram of a 29-year-old woman with rheumatic pancarditis who died a few hours after this examination. Necropsy revealed the endocarditis and a pericardial effusion of 400 c.c. Diameters: Valsalva, 14.2; Quiet, 15.2. Radiographically there may be observed a double outline in the whole inferior left arc and the waves are altered most with the characteristic of "uniform systolic blurring." This change is best shown in the procedure of Valsalva.

form systolic blurring movement was more evident during Valsalva's test than at rest, and more at rest than during Müller's (disappearing almost completely in order to make room for the full ventricular beats), in those cases in which the left ventricle was normal or at the most, showed some hypertrophy.

In a case in which the right ventricle was the larger, the opposite condition was observed, for the phenomenon was more evident during Müller's test. In this condition there was also observed a double contour and the uniform systolic blurring movement in the inferior part of the right border of the heart, and at this point the phenomenon was more evident during Valsalva's test than at rest and at rest more than in Müller's test.

The extent of the phenomenon is in direct relation with the thickness of liquid interposed between the ventricle and the pericardial sac. This is shown in those cases in which the double contour was visible (as in my cases), due to a decrease in the space which separated both contours during Müller's test. This is more clearly observed at the left border of the heart when the left ventricle is hypertrophied, inasmuch as the left ventricle increases its volume more than the right and pushes the liquid toward other parts of the pericardial cavity. If the right ventricle is the more hypertrophied, this would be the chamber which would dilate more during this test, and it would be the one to push the pericardial fluid toward the region of the left border, against the left ventricle. Under those conditions, there will be observed an increase in the space which separates the double contour instead of the decrease during Müller's test, but in the inferior part of the right border of the heart the phenomenon is more evident during Valsalva's test.

SUMMARY

Kymograms made during Valsalva's and during Müller's procedures are very useful in the interpretation of the ordinary kymograms obtained during respiratory rest.

They permit the determination of alterations of the waves due to the presence of small pericardial effusions which otherwise may pass unnoticed. The changes of the form of the waves are very important in the cases of combined valvular affection, infarcts of the myocardium, congenital anomalies of the heart, and cavities in communication with the cardiac chambers.

The variations of the transverse diameter of the heart, measured in a relative manner gives information concerning the existence of abnormal post-systolic residues and the capacity for adaption of the ventricular myocardium in acute overloaded states.

The author wishes to thank Professor Justo Montes Pareja for his suggestions in the course of the investigations, as well as the personnel of the cardiac clinic of which he is Professor, for their help in the clinical study of many of the cases.

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RATIONAL RADIOTHERAPY[1]

By G. W. GRIER, M.D., Professor of Roentgenology, University of Pittsburgh, *Pittsburgh, Pennsylvania*

ALTHOUGH some forty years have passed since x-rays were found to have a beneficial effect in the treatment of cancer, the sum total of definite and accurate information regarding this treatment is surprisingly small. As a matter of fact, the one thing about which there seems to be no disagreement, namely, the effect of the rays in skin malignancy, was discovered almost at once and there has been no fundamental alteration or addition of opinion regarding this particular condition since.

As early as 1902, when Pusey and Caldwell published their textbook on the roentgen rays, many cases of cancer of the skin were being treated and cured by this agent.

It is true that many refinements of technic which have resulted from the accumulated experience of subsequent years were unknown at that early period. However, the fundamental principle which underlies this type of treatment was no different at that time than it is now.

I refer to the use of radiation as a destructive agent. In skin lesions such a method of application is entirely practical. It is only necessary to know the amount of radiation required to destroy the involved tissues and to apply that dosage where it is needed, protecting surrounding normal tissues with lead. The normal structures beneath the lesion will not be destroyed because they do not receive as large a dose of rays as the diseased tissues above them. In this instance, the factor of tissue absorption and the inverse square law are both working favorably.

If the diseased area is situated beneath the surface of the body with normal tissues above and around it, both these factors are working unfavorably.

It is for this reason that the treatment of superficial lesions and of deep lesions are two entirely different problems.

In the treatment of superficial malignancy, it is only necessary to apply an escharotic dose to the involved area which then sloughs away, and in the vast majority of cases the resultant ulcer heals in by granulation. But such a system of treatment is obviously impossible when the cancer is situated inside the body.

If we accept this fact and forget entirely our experience in treating superficial lesions when we come to deal with deep-seated ones, I believe our progress in treating the latter type of case will be much faster.

The first, and apparently insurmountable, obstacle we meet when we attempt to treat deep-seated cancer by the destructive-dose method, is the fact that the lethal dose for most types of cancer cells is little different from that required to destroy normal cells. When treating superficial lesions, the destruction of a few normal cells around or beneath an epithelioma is a matter of little moment. However, if one is treating a carcinoma of the bladder, for instance, it is hardly practical to produce a sloughing of all the normal tissues in the region of the lesion in order to bring about a like effect on the cancer.

In practice, it has been found that the amount of radiation required to destroy an epithelioma of the skin, if applied so that the effect of all the treatment given is manifested at one time, is from seven to ten times a skin erythema dose, or about 6,000 roentgen units measured in air. If this dosage is applied to any normal tissues in a similar manner, it will produce sloughing.

I have reason to believe that this dosage is in reality a lethal dose for all types of cancer, both superficial and deep-seated. However, it is lethal only if applied so as

[1] This is one of a series of papers contributed by friends and former pupils of I. Seth Hirsch, M.D.

to be effective all at one time; not necessarily a single dose, but a single-dose effect.

This is very different from the theory advanced at about the time when 200,000-volt treatment apparatus came into general use. Those who were practising radiotherapy at that time will recall that 120 per cent of a skin erythema dose applied to the cancer was regarded as sufficient to destroy the lesion. This theory was not in accord with the experience of many who had been treating cancer for years, but it was generally accepted at that time. Treatment of deep-seated cancer was carried out on this basis for about ten years before it became generally accepted that this method was based on a false premise. As a matter of fact, this dosage is essentially all that normal intra-abdominal tissues will stand without injury if applied to produce a single effect. We know that the lethal cancer dose is about eight times as much as this. It is, therefore, obvious that no single-effect method of treatment can be successful in treating abdominal carcinoma.

I stress this because there has been a tendency lately to apply the Coutard method of treatment to all types of deep-seated malignancy. The Coutard method is a single-effect method of treatment, calculated to produce tissue destruction in exactly the same manner as we have been doing successfully in superficial malignancy for many years.

It is applicable in cancer of the larynx, mouth, or any region where sloughing of normal tissues around the lesion will not do any serious harm. It cannot be carried out in the same way in intra-abdominal lesions for obvious reasons, as I have already explained.

However, simply because an escharotic dose cannot be applied to intra-abdominal lesions does not necessarily imply that these lesions cannot be influenced, or perhaps even destroyed by radiation.

In considering this problem, it will be helpful to study the effect of treatment in locations that are readily observed, for instance, a subcutaneous malignant nodule in the chest wall, recurrent after amputation for cancer of the breast, or a metastatic gland in the axilla or supraclavicular region, or cervical metastases in cancer of the mouth. These are all cancerous lesions of a virulent type and are particularly difficult to handle because metastatic and recurrent lesions are more resistant to radiation than a primary one. Yet, everyone knows that these lesions can often be made to disappear entirely by properly applied radiation and without producing sloughing of the tissues, as is done in treating superficial lesions, or by the Coutard technic.

Certainly, small subcutaneous lesions can be treated by the single-effect method and using an escharotic dose if one so desires, but there is no advantage in doing so. If the mass is quite large, it is doubtful if it can be completely eliminated by any single-dose method that has been used up to this time. It seems evident, therefore, that although cancer cells and normal cells are destroyed by approximately the same amount of radiation if applied to produce a single effect, repeated smaller doses may bring about an entirely different effect.

A possible explanation of this phenomenon may be that normal cells recover more thoroughly, or more quickly, or in some other different manner from malignant cells. It would be extremely helpful if we knew the exact nature of this difference. Until this information is available, it would seem sensible to try to apply our knowledge regarding the treatment of visible subcutaneous lesions to those that are more deeply seated.

Our methods of measuring depth dose are now sufficiently accurate that it should be possible to apply the same dose to a cancer of the bladder as has been found adequate in a metastatic cervical node, for instance. It is true that the cervical node may be destroyed by methods that vary widely and some of these might not be applicable to intra-abdominal lesions. Conversely, it is my belief that a method which will not destroy the cervical node will be equally unsuccessful in cancer of the bladder.

In the author's experience, a funda-

mental principle underlying a fractionated dose technic is that an atrophic effect must be established with the beginning of the treatment, and subsequent treatments must be close enough together and of sufficient intensity to keep up this effect. If the initial dose is too small, or if the succeeding doses are too small or too far apart, instead of producing the desired destruction, the tissues develop a resistance to radiation which entirely defeats the purpose of the treatment. In recent literature I believe too much emphasis is being placed on total dose rather than method of administration.

I saw a woman a short time ago who had had her breast removed for carcinoma and some time later developed metastases to the bones of the pelvis. She was treated over the pelvis with x-ray therapy, using modern apparatus of 200,000-volt capacity. As reported to me, she received a total dose of 8,000 r units over the pelvis. Within a year she conceived and later bore healthy twins, although at the time of labor the pelvic bones and one femur were riddled with metastatic lesions.

It would seem evident to the most casual observer that a dosage of radiation, regardless of how many r units were applied, that would not sterilize a woman would have little effect on cancerous tissue. David R. Bowen used to say that the successful treatment of cancer depended on putting the cancer on the run as quickly as possible and keeping it that way. I agree with this general principle.

Undoubtedly there is a minimum dosage below which no beneficial results can be expected. Those who treated deep-seated cancer with x-ray therapy before the invention of the Coolidge tube, know this only too well. It should not be necessary to repeat the experience of those years.

Probably the revival of the method of frequently repeated small doses depends on the very successful Coutard technic. This, however, it must be remembered is simply a protracted single-dose effect and is applicable only to lesions that can be cured by a single dose. For other lesions, a method is necessary which will produce an injurious effect on both normal and cancer cells, and the interval between treatments should be such that normal cells will recover more fully than the cancerous cells. By a repetition of treatment the cancer will finally be entirely destroyed without too serious damage to normal tissue. Such a technic may be impossible of achievement, but with our present knowledge it seems the only way in which deep-seated cancer may be eradicated. Until now, no quality of radiation has been discovered which has a greater effect on cancer cells than on normal cells, although this is always possible and, if consummated, would alter the entire outlook of radiotherapy.

I am not certain that it is desirable to devise a technic whereby there is no systemic reaction to the treatment. I believe radiation sickness is the direct result of the action of the rays on the tissues. If this be true, a method of administration that produces no reaction, produces only a negligible effect upon the cancer. Consequently, one large dose should have more beneficial effect than the same amount divided into two or three doses.

I have no proof for this statement except experience, and I may be interpreting this experience wrongly, but I am convinced that there is a minimum dose below which treatment is ineffective. This dose is probably not the same for different types of malignancy, or for different individuals.

Probably it would be unwise to attempt to set an arbitrary figure for this dosage at this time, but every radiotherapist should realize very definitely that the subdivision of dosage may have an effect entirely different from that intended.

The other factor which has such an important bearing on the effect produced is the interval between treatments. If it be true that cancer cells and normal cells are affected in about the same manner by a given dosage of x-ray therapy, but that normal cells recover from this effect more quickly and more thoroughly, then it should be theoretically possible to cause destruction of cancer by repeated doses

without producing death of normal cells subjected to the same dosage.

However, in following out such a theory, it is readily seen that the interval between treatments is of paramount importance. Certainly not enough experimental work has been done on this factor. The only complete technic worked out on this basis is that of Coutard, which is a single-effect method and, to my mind, not desirable in many conditions. By this I mean that many cancerous lesions will respond better if given larger individual doses than are used in the Coutard technic, and at longer intervals than the customary daily treatment.

In treating intra-abdominal lesions, one is greatly handicapped by being unable to observe the effect of the treatment. Occasionally, undesirable effects are demonstrated at operation or autopsy, but this does not help much except as a warning of what not to do.

Naturally, there is no substitute for calculating the depth dose on various intra-abdominal organs before a projected series of treatments is given. If this is accurately calculated by any accepted method and the effect of the treatment on the bladder mucosa noted by frequent cystoscopic examinations, one can obtain a very reasonable idea of what is actually being done to abdominal organs by the technic in use.

I do not believe one can hope to destroy cancer with any dosage which does not produce inflammation and edema of the bladder mucosa, and not by one dose of this quantity. However, if this dosage can be given accurately, it can be repeated several times at appropriate intervals. I have seen carcinoma of the bladder disappear entirely following treatment carried out in this manner.

Although x-ray apparatus and measuring devices are now developed to the point at which any given dose can be accurately applied, unfortunately, it is still not possible to prescribe a standard course of treatment which can be depended upon to produce a desired effect. This is partly due to the fact that malignant lesions of different types respond differently, and, more particularly, to the location of the lesion, which may alter the effect tremendously. However, more important than any of these is the individual himself. We may or may not believe that an individual has a systemic resistance to cancer, but certainly no one having considerable experience in the treatment of cancer with radiation doubts that there is a wide variation in the reaction of patients to identical treatment. For this reason, there is no substitute for judgment and skill on the part of the radiotherapist in adapting the treatment to the individual case.

CYSTIC DISEASE OF THE LUNG[1]

By L. R. SANTE, M.D., *St. Louis, Missouri*

SINCE the report of Koontz, in 1925, of 108 cases of cyst of the lung collected from the literature, our knowledge of this subject has been enhanced by the reports of many additional cases. By 1937, the number of reported cases had reached 381, as collected by Schenck. It is quite probable that some of these cases were reported as cysts without adequate proof of their true cystic character, but it is also true that many other cases have been observed which have not been reported. At any rate, the condition is much less uncommon than it was previously thought to be.

No attempt will be made to review the literature in detail: references will merely be made to specific cases or reports pertinent to the discussion; the reports of numerous interesting cases are contained in the bibliography. For a clinical review of the literature the reader is referred to King and Harris, Wood, and Maddox; for a review of the pathologic findings to Chodkowska; for a discussion of the mechanism of formation to Mueller, Dubrow, and Anspach and Wolman; for differential diagnosis to Anspach and Wolman, Peirce and Dirkse.

At first, the air cyst was observed with its tendency in certain instances to assume expansile type; then the fluid cyst was seen with discharge of its contents and replacement by air, thus establishing the connection between the two types. It was assumed by some that all *cysts* were congenital and that all went through these same stages. Now it has been recently shown (Peirce and Dirkse) that the same series of events can take place in a previously healthy individual with ultimate complete recovery.

Since it is thus established that the manifestations of cystic disease of the lung may be either congenital or acquired, it at once becomes evident that the condition is produced as a result of certain mechanical forces which operate in response to certain structural changes in the lung, regardless of whether these changes occur from developmental defect or acquired disease. Might it not be well, therefore, to direct our attention to the character of these changes and consider how they may be brought about, since only by a thorough knowledge of their operation can the condition be intelligently treated.

First of all, let us consider out terminology. Let us apply the term *congenital* only to those cases in which there is absolute proof of the congenital origin of the lesion.

Let us limit the term *cyst* to confined collections of fluid within the lung. If we consider a cyst in the general sense as, "any sac or dilated space, normal or abnormal," then the term cyst could be applied to any space in the body; but if we consider a cyst in the commonly accepted sense, as an abnormal sac resulting from partial or complete occlusion of a secretory glandular structure, then, obviously, the air-filled cavities do not fulfill these conditions.

Let us refer to air-filled cavities as *pneumatoceles*, as suggested by Peirce and Dirkse, with certain qualifications as to their size, location, or behavior, as, for instance, "large solitary pneumatocele," or "expansile pneumatocele," or multiple "emphysematous pneumatocele," or multiple "bronchiectatic pneumatoceles."

Having defined our terms, let us proceed to the consideration of various types of lesion referred to as *cystic disease*. One of the most common types is seen as multiple thin-walled pneumatoceles, clustering about the larger bronchial branches in the hilum regions and adjacent areas, giving

[1] This is one of a series of papers contributed by friends and former pupils of I. Seth Hirsch, M.D.

rise to the condition referred to as *cystic bronchiectasis* (Fig. 1-*D*). When the cavities are small and their walls are thick the term *honeycomb* (Chodowska) has been applied to their appearance. This type of

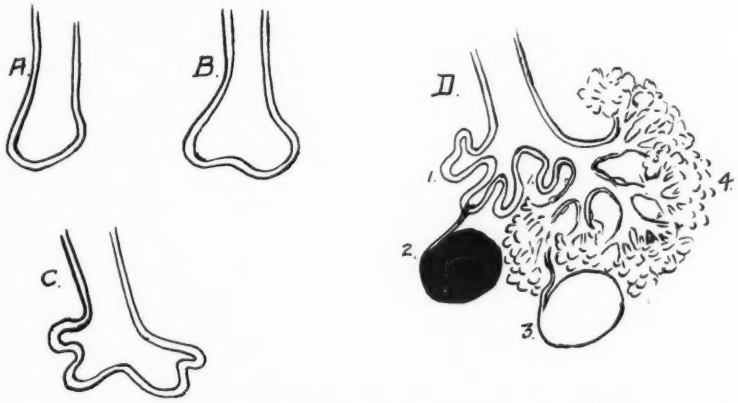


Fig. 1. Schematic drawing showing production of anomalies during development of lung structure, as suggested by Mueller, King and Harris, and Dubrow. (*a*) The lung develops from evaginations of the larger bronchial branches. (*b*) These show enlargement of the advancing end of the pouch with indentation or folding of the end of the sac which leads to division of the bronchus. (*c*) Subsequent divisions and subdivisions continue in this manner. Ultimately this process leads to the complete development of normal lung structure as shown in *d*-4. (*d*) Mal-development of the lung may occur at any point in its development. (1) It may be arrested at the larger bronchial branches giving rise to multiple small pneumatoceles—congenital bronchiectatic type. (2) Its growth may be suspended for a time, only to start in again, resulting in complete or partial atresia. Subsequent secretion of the lining membrane may produce a fluid cyst. This may later empty into the bronchus and refill with air. If a check-valve is formed, the pneumatocele may expand to large proportions. (3) The anomalous development may occur in the terminal air structure beyond the point of mucus secretion, resulting in large pneumatoceles.

involvement is well illustrated by the following cases.

Case 1 (Figs. 2 and 3-*A* and 3-*B*). Colored male, aged 62 years, was sent in for x-ray examination of the chest from the out-patient department, on Feb. 11, 1937, because of a history of occasional chest pains and dry non-productive cough. There was no history of hymoptysis.

The past history disclosed the following diseases without complications; pertussis at 16 years of age, measles at 18 years of age, and pneumonia at 59 years of age. He thought that he had had influenza, in 1918, during the epidemic, but was not sufficiently sick to be confined to bed. Only small quantities of mucoid material were expectorated but reported sputum examinations were always negative for tubercle bacilli. The temperature, pulse, and respiration were normal.

X-ray examination of the chest revealed multiple, thin-walled cavities clustered about the hilum regions and in both lower lobes. There was no infiltration or consolidation in either lung and no evidence of other parenchymatous pathology. Intratracheal injection of iodized oil showed that all of these rounded cavities communicated directly with the larger bronchial branches and that the cavities themselves were merely the rounded ends of blind pouch-like evaginations from them. These pouches did not contain any detectable amount of secretion and there was no evidence of any inflammatory reaction in the surrounding tissues. While the picture was typically one of bronchiectasis, there were no clinical signs for support of such a diagnosis. Observation more than a year later revealed little, if any, change

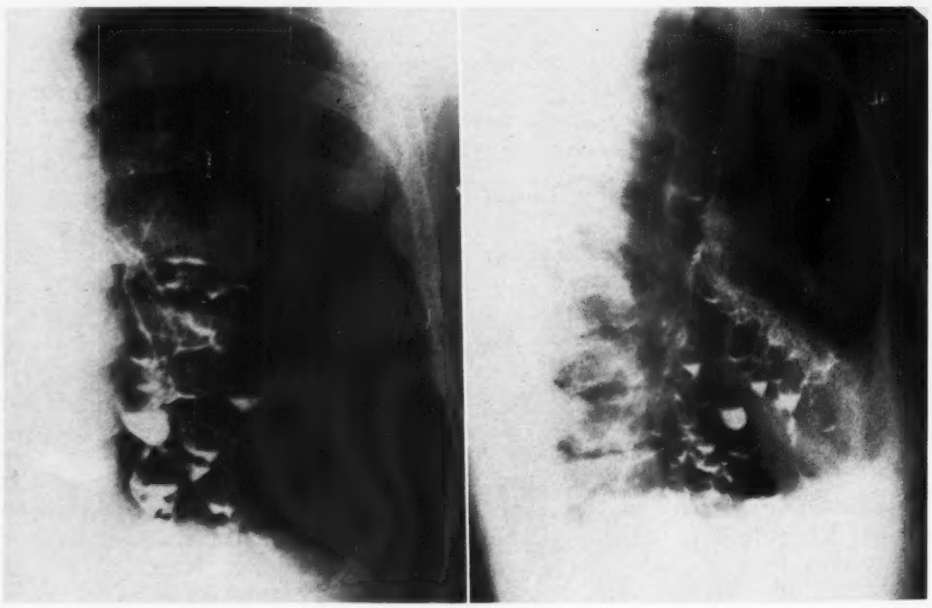
Fig. 2. Case 1. Numerous ring-like shadows about both hilum regions showing no change over a considerable period of time, without symptoms of infection.

in the condition and still showed no evidence of infection.

Case 2 (Figs. 4 and 5). H. I., white female, 29 years of age, entered the hospital on Dec. 9, 1935, with the chief complaint of headache. She had had the usual childhood diseases without complications. She denied any previous cough or expectoration, except for occasional head colds from which she always recovered promptly. Within the last few years she had had attacks of precordial pain which caused her to sit up in bed, but this she attributed to her high blood pressure.

She had always enjoyed good health, up to three months prior to admission. At that time she experienced a sudden hemoptysis of about two teacupfuls of blood without other symptoms. She had never had hemoptysis before nor has there been any since this period. This attack was not accompanied by fever or any other sign of illness.

Sputum examinations of scanty specimens on several occasions failed to reveal tubercle bacilli. The urine was essentially



A *B*

Figs. 3-*A* and *B*. Case 1. After intratracheal injection of iodized oil, these were seen to be dilated air-filled sacs communicating by large openings with the larger bronchial branches. These areas may be characterized as multiple pneumatoceles of congenital bronchiectatic origin.

negative, as was the Wassermann test. Her blood pressure was 168/104. Pulse rate, respiration, and temperature were normal.

X-ray examination of the chest at this time showed numerous ring-like shadows along the entire mediastinal border of the left lung. There was no infiltration or consolidation in either lung and no other indication of pathology. There was no detectable secretion in the sacs and no evidence of surrounding inflammation. Iodized oil injection showed free communication of these larger cavities of the larger bronchi on the left side in rather orderly arrangement. In view of the lack of evidence of infection over a considerable period of observation, the condition must be considered as multiple pneumatoceles of bronchogenic origin or *congenital bronchiectasis.*

Case 3 (Fig. 6). L. L., white female, aged 57 years, entered the hospital on April 26, 1937, for an old fracture of the femur. She gave a history of having had the usual childhood diseases but denied any complications. She had suffered from chronic non-productive cough and periodic attacks of dyspnea for a long time but had never had large amounts of expectoration nor signs of infection. There was no hemoptysis. The Wassermann and urine tests were essentially negative.

X-ray examination of the chest showed multiple small *cyst*-like cavities in the upper third of the right lung. The walls were thicker than those of the previous case, giving rise to a honeycomb appearance. There was no change in appearance over the entire period of observation and no evidence of other disease.

Another illustration of this type of involvement was described by the author, in 1929 (Sante, 28–1). In another instance encountered in 1921 a diagnosis of chronic diffuse interstitial fibrosis with

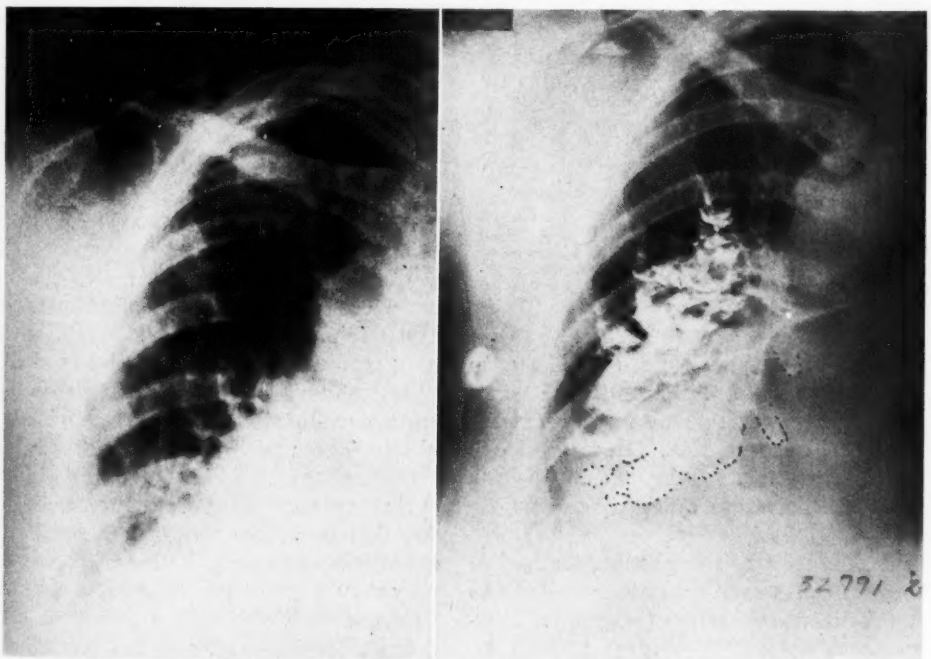


Fig. 4. Fig. 5.

Fig. 4. Case 2. Multiple rounded ring-like shadows on the right side in the hilum region in a woman 29 years of age, discovered incidental to a general examination. No symptoms of pulmonary infection.

Fig. 5. Case 2. Intratracheal injection revealed these to be large air-filled pouches connected by large openings to the larger bronchial branches in rather orderly arrangement. These might be spoken of as multiple bronchiectatic pneumatoceles or congenital bronchiectasis.

cavity formation was made (Sante, 28–2). Multiple ring-like shadows were present throughout one entire lung of an 18-month-old child. There was no adequate explanation for these air spaces and it was

Fig. 6. Case 3. Similar type multiple pneumatoceles in the hilum region of small size with thicker walls, producing the appearance characterized as "honeycombed."

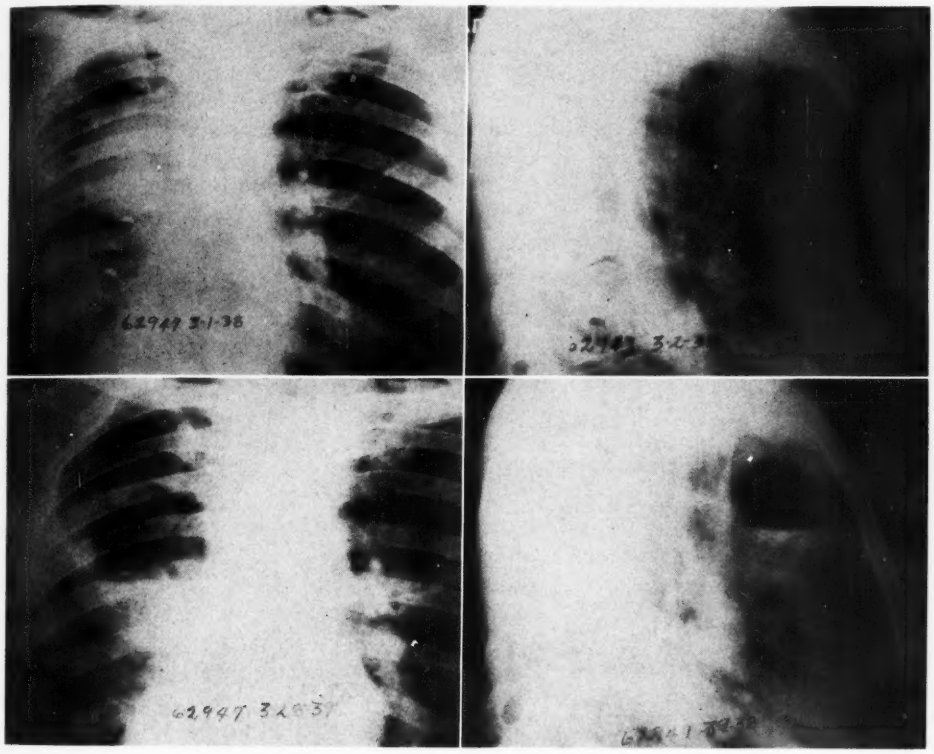
assumed that they were secondary to chronic interstitial fibrosis of the lung. There was no change over an extended period of hospitalization. In view of our present knowledge, I feel sure that this was a case of congenital *cystic* disease of the lungs.

Consideration of the possible method of development of such conditions leads us to the following speculation (Mueller). During embryological development (Fig. 1), the lung structure develops from bronchial buds growing outward from the larger bronchial branches. Should a group of these pouch-like outgrowths become arrested in their growth and not continue in their natural development, a condition would arise essentially similar to that seen in these cases. As long as infection does not occur, such patients might go on for years, even into adult life, without any manifestation of their presence. The walls of these cavities are relatively strong and resistant, being composed of elements of bronchial structure often containing cartilage. They maintain a wide open communication with the larger bronchi and air enters and leaves readily with each respiration. They have a mucous membrane lining. If it were not for their rigid walls they would completely collapse and refill during each respiratory cycle.

Pneumatoceles of this type are rarely seen at the periphery of the lung; they are not associated with interstitial fibrosis. If infection occurs, the condition becomes essentially the same as bronchiectasis and must be regarded as such. Whether or not all cases of bronchiectasis have their origin in this manner, subsequently becoming infected, it is impossible to say, but there is ample indication that bronchiectasis can also be acquired from the effects of chronic inflammation. Chronic nasal sinus or other infection resulting in fibrosis and destruction of the peripheral structures may leave only blind bronchial pouches.

The next type of lesion for consideration is the *fluid cyst*, which seems to conform more closely to our conception of a true cyst. That congenital fluid cysts of the lung really occur, there can be no doubt, since instances are on record in which such epithelium-lined sacs have been present at birth. There are, however, relatively few proven cases of fluid cysts in adults. Fluid cysts appear roentgenographically as rounded areas of increased density, frequently central near the hilum region but they may occur at any location in the lung. In some cases the fluid sac may be elongated in the region of the interlobar septum, taking on the appearance of an interlobar effusion. These areas may show little change over long periods of time and it is this persistence of the lesion without evidence of inflammation or infection which

is a very important point in the diagnosis. Yet this is by no means characteristic since we have seen localized encapsulated empyema and even lung abscesses so completely walled off by fibrous tissue that they showed mittently discharge its contents, producing a pleural vomica. Likewise, if the localized effusion is in the interlobar space it may even give rise to an appearance of being within the lung. If the



A *B*

Figs. 7-*A* and *B* (*above*). Case 4. A rounded, well-defined shadow in the left hilum region which appeared during an acute inflammatory process in the chest and remained unchanged for several weeks. *A*, anterior view; *B*, lateral view.

Figs. 8-*A* and *B* (*below*). Case 4. Discharge of fluid content into a bronchus disclosed the fluid character of the lesion and eliminated possibility of newgrowth. The patient was operated on for empyema and made complete recovery. A pleural vomica of this sort could easily be mistaken for fluid cyst. *A*, anterior view; *B*, lateral view.

no change over a period of years and gave no manifestation of infection. At this stage, lung cysts may resemble newgrowths; usually, however, newgrowths show some progressive enlargement. After a time, fluid cysts usually discharge their contents in whole or in part into the bronchial system. This is likewise a potent but by no means an absolute factor in the diagnosis. A localized pleural effusion may rupture into a bronchus and inter- fluid be of mucoid nature and not purulent, this is also a favorable point in the diagnosis of a true cyst. In some instances the sac remains partly filled with air after intermittent discharge of the fluid contents; in others, the fluid is completely evacuated never to return and the sac becomes filled with air, giving rise to a pneumatocele.

Certain discrepancies which may arise in the diagnosis of a fluid cyst are well illustrated by the following cases.

Case 4 (Figs. 7 and 8). A. H., white male, 37 years of age, entered the hospital on Jan. 30, 1938, with cough, respiratory infection, and pain in the left chest. His temperature was 101°, pulse 85, respiration 35, white count 21,000. An x-ray examination of the chest on Feb. 1, 1938, showed pleural effusion. On Feb. 2, 1938, 700 c.c. of clear yellow fluid was withdrawn. The pleural effusion later became purulent.

X-ray examination of the chest on March 1, 1938, showed a rounded well defined shadow centrally located, observed during the course of an acute inflammatory process in the chest. This area was observed over a period of four weeks, during which it showed little change. Then it discharged into a bronchus and partially emptied, showing a fluid level. This is a good example of a condition which could easily be characterized as a fluid cyst, while it undoubtedly was actually due to pleural vomica resulting from a previous inflammatory process. The patient was subsequently operated upon for empyema and made a complete recovery. Repeated reference is made in the literature to the influence of infection in activation of previously dormant cysts; cases have been shown in which fluid cysts presumably have developed following pulmonary infection. The remarkable cases cited by Peirce and Dirkse, and Rigler are striking examples of the influence of infection in production of cyst.

Case 5 (Figs. 9 and 10). J. S., white male, aged 54 years, entered the hospital on Jan. 10, 1938, with chief complaints of anorexia, weakness, loss of 20 pounds in weight, night sweats, non-productive cough, and an oppressed feeling in the chest for the previous two months. The past and familial histories were essentially negative, except for a mild hypertension which the patient had had for the past two years.

Physical examination was essentially normal, except for bilateral lens opacity and inspiration lag on the right side of chest, slight dullness over the base of the right chest, posteriorly; moderate mid-dorsal kyphosis. The blood pressure was 154/90; systolic murmur over the apex. His temperature was 98.4°; pulse, 92; respiration, 30. The urinalysis was negative. The white blood count ranged between 9,600 and 11,950; red blood count, 2,960,000. Hemoglobin was 70 per cent; no eosinophilia. The Kahn test was negative; sugar, 86 mgm.; N.P.N., 16; cholesterol, 249.

X-ray examination on Jan. 10, 1938, revealed a large rounded area about ten centimeters in diameter in the lower right lung-field, extending outward from the mediastinal shadow. The margins were sharp and clear-cut and the area showed homogeneous density. There was no evidence of pathology elsewhere in either lung. Kymographic examination failed to reveal any evidence of pulsation.

Repeated attempts to aspirate the mass in the right lower lung-field using a large gauge needle failed to yield any tissue or fluid for examination.

Repeated x-ray examinations showed gradual but progressive regression of the shadow for several months until it completely disappeared.

Re-examination of the chest one year later failed to reveal any evidence of parenchymatous pathology. The lung was fully expanded. It would be possible for such a condition to be ascribed to cyst of the lung; whereas the diagnosis even after complete recovery still remains obscure.

Returning again to our scheme of embryological development, we find that a wide variety of congenital lung defects have been reported. Hurwitz and Stephens have collected 35 cases of agenesis of the lung, and many other defects have been noted. A bronchial bud may fail for a time during its growth to undergo proper tubular development (Mueller), resulting in complete or partial atresia of the lumen of the structure, the rudimentary bronchiole being represented only by a cord, very similar to development of congenital atresia of the esophagus or intestines. Subsequent resumption of growth and expansion of the distal portion may produce an enclosed

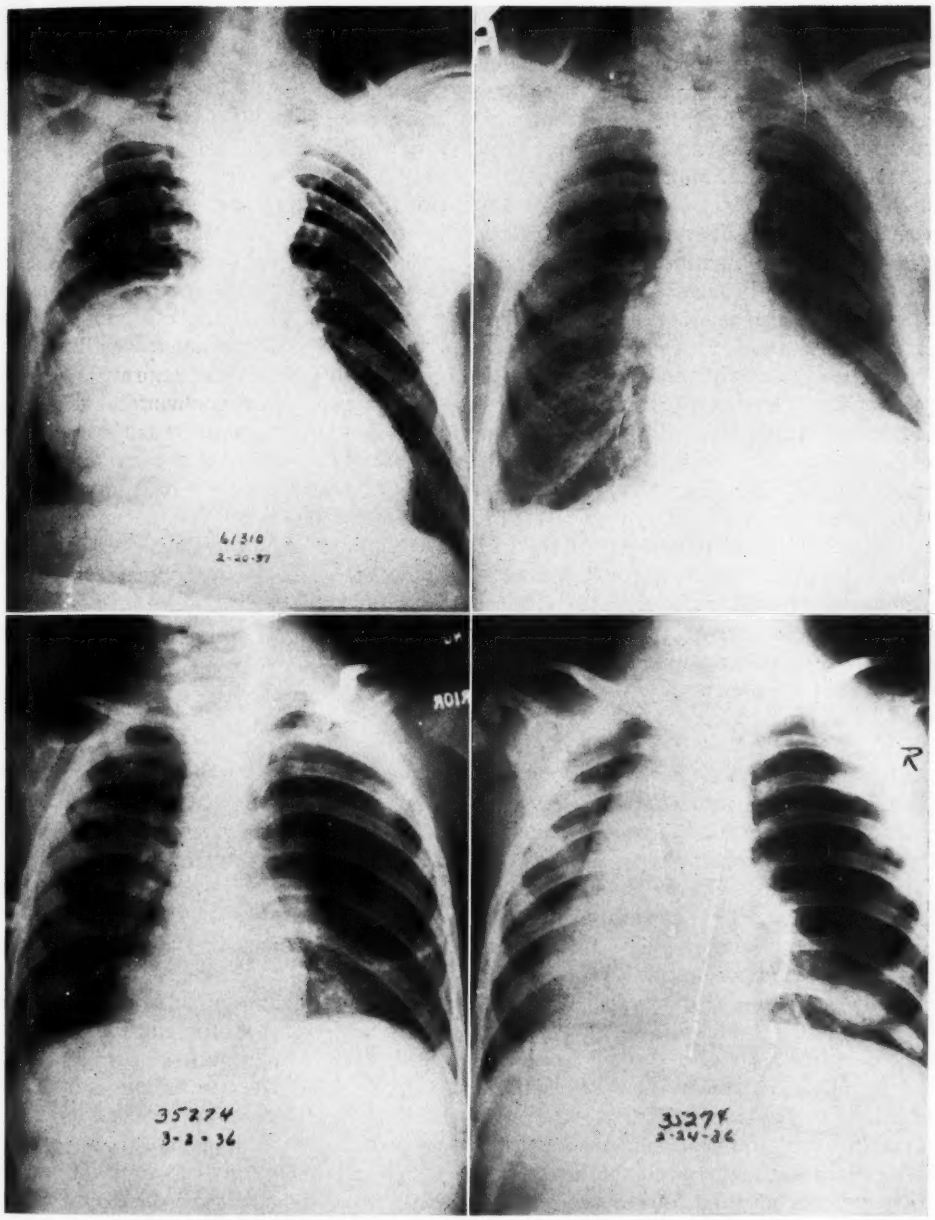


Fig. 9 (*upper left*). Case 5. Large rounded area about ten centimeters in diameter in the lower right lung-field extending outward from the mediastinal shadow. Repeated attempts at aspiration were fruitless: no evidence of infection.

Fig. 10 (*upper right*). Case 5. This gradually became smaller in size over a period of several months, with final complete absorption.

Fig. 11 (*lower left*). Case 6. A large solitary pneumatocele shown at full inspiration in a child one year of age. Note that the mediastinal structures do not show any displacement at this phase of respiration, indicating that the air content is not greater than atmospheric pressure at this time.

Fig. 12 (*lower right*). Case 6. Similar examination in expiration showing no reduction in size of the pneumatocele but showing a displacement of the heart and mediastinal structures to the opposite side.

cavity with secretory epithelium which results in a fluid cyst. This error in growth would have to occur in a smaller bronchiole, nearer the periphery, yet one having a sufficiently muscular coat and elastic fibers to permit expansion, but still retaining a mucous membrane lining. The cyst continues to enlarge until the pressure of its contents inhibits further secretion from its membrane. Rupture of the cyst into a bronchiole may result in complete evacuation of the cyst. The forces which tend to raise the pressure within the cyst are the tension of the elastic cyst capsule and the pressure of the surrounding normal lung structure. These, then, are the forces which tend to cause evacuation of the cyst after it ruptures. Evacuation may be either through a large opening which permits permanent collapse of the cavity and cure, or through a smaller opening which still remains patent.

Once collapsed, why should the sac again fill with air acting against the pressure of surrounding lung structure which still remains as a potent force resisting re-expansion? The factors concerned in subsequent inflation of the sac are the ratio of resistance of the cavity wall to the resistance of the normal alveolar structure supplied by a bronchiole of similar size. If the opening permits free passage of air on inspiration and expiration, then obviously air should enter more freely than it would into the adjoining alveolar structure since the flail cavity wall offers little resistance to inflation. The forces of deflation exerted on the cavity would be less pronounced, since it would not be subjected to the force of elastic recoil of its walls until inflation had re-filled the cavity with air up to a size almost equal to that of the original fluid cyst. At this point, any further air gained on inspiration should be lost on expiration and a definite interchange of air should be established equal to that of an equivalent amount of lung tissue. Such a small amount of change might be difficult to see during respiration, but it should not be so great that on expiration there would be evident displacement of the heart and mediastinal structure to the opposite side. The air in the cavity should never exceed atmospheric pressure, since it enters passively from the outside. When such a condition is seen in which the heart and mediastinal structures are displaced to the opposite side *on expiration* from pressure of a pneumatocele, but return to normal position *on inspiration*, it implies a simple check-valve at the inlet of the cavity. Since the act of inspiration is passive, a simple check-valve might retain the pressure in a pneumatocele at atmospheric pressure during expiration causing displacement of the mediastinal structures, but should not continue to cause expansion. This results in a *non-expanding pneumatocele*, varying only slightly with respiration without causing displacement of the mediastinal structures at height of inspiration. In certain cases, pneumatoceles may continue to expand. Cases have been reported in which the pressure developed in these pneumatoceles was sufficient to cause herniation through the mediastinum into the opposite pleural cavity (King and Harris). Death has resulted in a number of instances from such uncontrollable expansion. Obviously, a single check-valve will not explain the extreme degree of pressure sometimes obtained. Expanding pneumatoceles of this type have been referred to as *balloon cysts*.

The mechanism by which such excessive pressure is developed is difficult to understand. It may be due to the presence of an accessory air chamber acting as a vestibule to the main pneumatocele, so arranged that the movement of the chest wall during respiration exerts an additional force beside that of atmospheric pressure which might act as a pump, filling the cavity. It would seem obvious that to secure such high pressure it would be necessary for some additional force to be expended beside the passive equalization of air pressure.

Even this sequence of events in itself may conceivably be simulated by a localized pleural effusion rupturing into a bronchus with formation of a check-valve

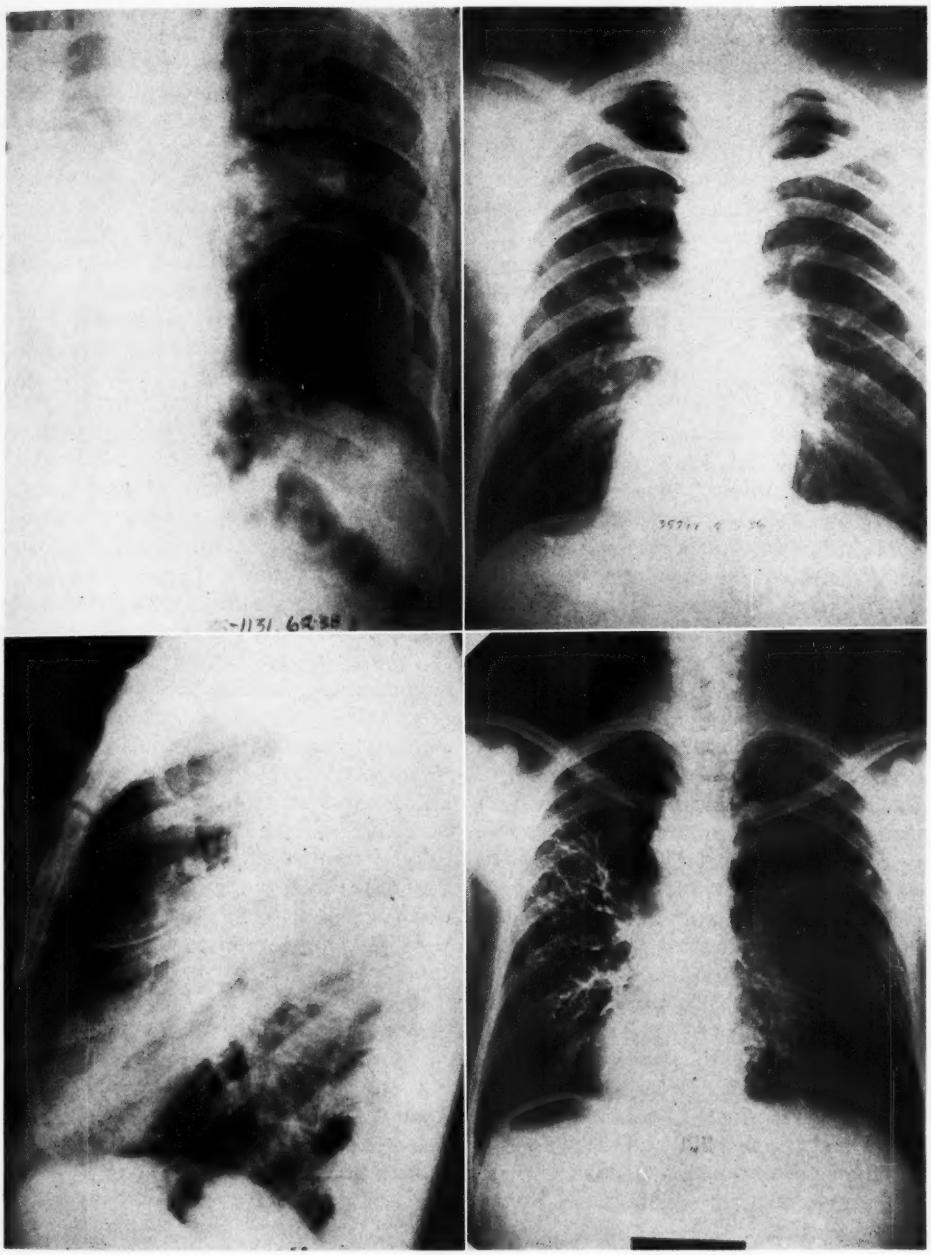


Fig. 13 (*upper left*). Case 7. A large rounded, thin-walled pneumatocele about ten centimeters in diameter in the left pleural cavity, just above the diaphragm and posterior to the heart. The history indicated that this had been present for over ten years.

Figs. 14-*A* (*upper right*) and *B* (*lower left*). Case 8. Large pneumatoceles occupying the upper portion of both lungs. *A*, anterior view, in which the lung markings are absent from these regions but the walls of the air sacs cannot be visualized. *B*, lateral view shows clearly the limiting wall of the pneumatocele.

Fig. 15 (*lower right*). Case 8. On intratracheal injection, iodized oil fails to extend into this portion of the lung.

mechanism of similar nature. There is no reason why such a condition could not occur, and, if the original sac were produced by the interlobar pleura, the resulting pneumatocele would appear to be within the lung even if pneumothorax were induced as a diagnostic procedure. An air sac may begin to expand at any time, and varying types of valve mechanism may be present. At any rate, it may be assured that any air sac which remains absolutely the same during inspiration and expiration must have some type of check-valve. This type is well illustrated by the following case.

Case 6 (Figs. 11 and 12). A. G., white male infant, one year of age, entered the hospital on Feb. 20, 1936, with an upper respiratory infection. There was a history of cough all winter, with acute illness starting three days prior to entrance into hospital, with chill, fever, and pain in left ear. Nothing in the past history seemed of significance. Birth was normal, respiration spontaneous, weight seven pounds three ounces at birth. There were no convulsions. Subsequent developmental history was normal; there was no history of previous contagious disease.

Examination at this time disclosed adenoids and bilateral otitis media. The temperature was 103° on admission. There were no symptoms referable to the chest at this time or at any time during the child's life. Routine x-ray examination revealed a large rounded air space on the right side, devoid of lung markings, almost filling the pleural cavity. There was no indication of change in size of the air sac during respiration. Repeated examinations for several months showed no change and the child experienced no distress.

Similar solitary pneumatoceles are sometimes seen in adults, as is illustrated by the following instance.

Case 7 (Fig. 13). S. L. D., white male, aged 43 years, entered the hospital on June 2, 1938, complaining of diarrhea and weakness. His symptoms dated from 1928, when he had an attack of "intestinal flu" and colitis. Has not been able to work since that time. In 1930, he had a paratyphoid infection and was sick for three or four weeks. In 1930 and 1931, he had amebic dysentery. *In 1929, on x-ray examination, he was told that he had a cyst in his lung.* Temperature, pulse, and respiration were normal. Blood and urine examinations were essentially negative. The sputum was negative for tubercle bacilli. X-ray examination of the chest made June 2, 1938, revealed a rounded thin-walled pneumatocele, fully 10 cm. in diameter, occupying the left pleural cavity posterior to the heart. At no time during the period of observation did it contain fluid and there was no evidence of other pathology in either lung. The size of the cavity did not change during respiration and there was no change in appearance at any examination. There were no symptoms referable to the chest and the condition was discovered on routine examination.

On intratracheal injection, lipiodol does not enter the devious pathways into the air cavity in such types and would no longer seem to be indicated as a diagnostic procedure under such conditions. Inspiration and expiration films will demonstrate the lack of expansion of the lesions and indicate at once the check-valve type of the condition; whenever this is established, lipiodol injection into the lung would no longer seem necessary. Some observers feel that rupture of a fluid cyst precedes the development of all air-containing pouches or pneumatoceles, but there does not seem to be any logical reason why a check-valve type of opening must be made by rupture of a fluid cyst and could not be the direct result of congenital mal-development, inflating primarily with air at the time of birth.

Pneumatoceles which arise from the peripheral lung structure are usually large, having extremely thin walls; they are often multiple, and are not infrequently bilateral. As far as I have been able to find, they are not preceded by fluid cysts and do not have a secretory lining membrane. They occur frequently in adults and their site of involvement is often in the upper lobes. The limiting membrane

may be invisible in the postero-anterior view, giving rise to a loss of lung markings in the area of involvement not unlike the appearance of pneumothorax, but in the lateral view the limiting membrane is as a rule clearly visible in such cases. Absence of collapse of the lung elsewhere is indication of the true nature of the disease.

Pneumatoceles of this sort constitute the bullous form of emphysema, they may show no change for long periods of time, or they may show continuous progression, almost completely replacing the lung structure.

Case 8 (Figs. 14-*A*, 14-*B*, and 15). E. S., white male, aged 31 years, entered the hospital on Feb. 26, 1936, with the complaint of loss of weight, restlessness, and cough. He gave a history of the usual childhood diseases without complications. He had no unusual respiratory disease except a chronic dry non-productive cough for the past year. He had contracted syphilis, in 1923, and his Wassermann test at this time was 4 plus. No fever or other indication of infection was present. His blood pressure was 125/85. He had been well, until two months before entrance into hospital, when he began to lose weight; he lost 15 pounds in two months.

X-ray examination of the chest on Feb. 26, 1936, revealed lack of lung markings throughout the upper portions of both lungs. On lateral view examination these areas seemed to be bounded by thin membranes. There was no evidence of inflammatory process in either lung and no indication of pneumothorax.

Further x-ray examination on April 15, 1936, after the intratracheal instillation of lipiodol, revealed normal bronchial structure throughout but failed to reveal any free communication of these areas with the bronchial structures.

That the pneumatoceles in this type of involvement do have bronchial connections there can be no doubt, otherwise they could not maintain their air contents. The process in this instance is probably similar to that already described, with check-valve permitting air to enter but not to leave the air sacs produced by the tortuous tiny air passages. These are so small that lipiodol cannot enter.

They may occur from congenital defects in the elastic structure of the alveolar walls, causing them to be less resistant to filling on inspiration and less patent than normal in emptying on expiration, due to their lack of normal elastic recoil. When the two forces thus concerned become equalized, the pneumatocele stops enlarging. Cases have been reported in which bullous pneumatoceles of this sort continued to expand until they replaced almost the entire lung space of both pleural cavities (Burke).

Such expanding types of pneumatoceles may also be acquired in association with development of emphysema. Emphysema, wherever it is found, is always associated with interstitial fibrosis. Any condition which interferes with passive expiration requiring muscular effort, whether or not this be from narrowing of the bronchiole as a result of muscular spasm or fibrosis, will have a tendency to produce emphysema. The alveolar walls are delicate membranes, consisting of a single layer of flat epithelial cells permitting intimate exposure of the surrounding capillary plexus to the air. Over-distention of the terminal air sacs results in rupture of these thin-walled septa, thereby permitting still greater enlargement of the terminal air sacs. This, in turn, further reduces the normal elasticity of the cell wall, permitting further expansion. Under certain circumstances, a valve-like action may be produced at the opening of the bronchiole, permitting air to enter but not to leave, pumping up the air space until proper equilibrium is established for these conditions. When this is established, the pneumatocele remains constant, showing no demonstrable change during respiration.

Emphysematous blebs may form in the pleural surface in relatively young healthy individuals. These may at times be demonstrated by lipiodol injection. Correlation of the evidence which we have of the development and behavior of fluid cysts and pneumatoceles of the lung with the me-

chanical and dynamic factors concerned in respiration would lead us to conclude:

1. That fluid cysts and pneumatoceles of the lung arise as results of definite derangement in the lung structure.

2. That these derangements can be either congenital from faulty embryological development or acquired from infection and fibrosis, so that any of the forms described can be congenital or acquired.

3. That the factors which primarily influence the degree of inflation of such pneumatoceles, *in which free bronchial connection is present,* are the relationship of the resistance of their walls to the resistance of normal alveolar structure supplied by a bronchiole of equal size to the opening supplying the cavity. *The pressure in the pneumatocele cannot exceed atmospheric pressure.* On x-ray examination there should be no deviation of the mediastinum at any time.

4. That *in instances in which a simple check-valve opening permits entrance of air on inspiration but checks it on expiration,* the pneumatocele will enlarge in size until an equilibrium is established; *the pressure within the pneumatocele cannot become greater than atmospheric at maximum inspiration* but may exceed this at expiration, also causing the mediastinum to be in normal position on maximum inspiration, but displaced to the opposite side on expiration.

5. That *pneumatoceles which continue to expand* showing higher than atmospheric pressure at all times during the respiratory cycle would seem to *require the addition of some unusual pumping force* to account for their expansile character.

6. That fluid cysts may result only when the defect involves a bronchial structure which still retains secretory power.

7. That pneumatoceles arising from alveolar structure as a result of emphysematous involvement should not be preceded by fluid cysts, since they are not lined by secretory epithelium.

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THE TREATMENT OF POLYCYTHEMIA VERA WITH THE ROENTGEN RAY[1]

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DURING the past 10 years, only eight cases of polycythemia vera were observed in the Radiation Therapy Clinic, at Bellevue Hospital. This indicated the relative infrequency of this blood disease which has proven satisfactorily amenable to x-ray therapy.

Polycythemia vera should be distinguished from other conditions that produce an increase in the red cell count, which may be relative or absolute, the latter occurring as a primary or secondary condition.

A relative increase in red cells and hemoglobin may be evidenced in the blood as a result of dehydration. Its existence is usually short-lived and easily recognizable. An absolute increase in both red cells and hemoglobin may be traceable to some definite etiological factor, and, if such be known, the disease is distinguishable from the true polycythemia. Secondary red count increases of known cause are found in individuals in high altitudes; also those with chronic pulmonary disease such as silicosis, and Ayerza's disease.

The physiological explanation for absolute increase in red cells and hemoglobin lies in the need for ample oxygenation, which can be accomplished only by an increase in the elements capable of this function.

A polycythemia in which no definite etiological factor can be isolated is the "vera" type. The literature discloses some cases in which tuberculosis of the spleen was associated with the disease, but there are other instances in which tuberculosis of the spleen is not accompanied by any blood phenomenon. While some maintain that the spleen has lost its erythrolytic power, the nature of the disease presumably does not lie in malfunction of the spleen, for splenectomy often induces merely a transitory elevation in the red cell count.

Pathology.—Although the etiology of polycythemia vera cannot be determined, the pathological anatomy is constant. Hyperplasia of both the erythropoietic and leukopoietic centers in the bone marrow, with increased redness and engorgement, are present. Aside from its enlargement and engorgement, the spleen reveals no histological alterations. The blood vascular tree shows dilatation of the lumina, and there may be numerous hemorrhages, especially in the brain.

Symptoms.—The symptomatology is variable. In four patients, pain, swelling, and tenderness in the legs were the dominant complaints. This picture is explained on the basis of venous channel dilatation which is enhanced by hydrostatic pressure in the lower extremities. Another patient, a 39-year-old male, presented as the chief complaint excessive sweating and morning headaches, both of two years' duration. Another, a 45-year-old female, complained of fullness in the head and spots before the eyes. Two patients had symptoms in the abdomen: one complained of pain in the left upper quadrant; the other stated that she had been aware of an abdominal tumor for 12 years. The tumor was the spleen. It becomes apparent, therefore, that the symptoms in most cases are based upon the dilatation of the vascular tree by blood which has increased in both volume and viscosity.

There is no characteristic age group. Ages of patients in this series were 39, 45, 46, 52, 52, 56, 60, 62, indicating a more common appearance after the third decade with the greatest number in the fifth.

Both sexes seem to be equally prone to the disease; in this series, there were four males and an equal number of females.

[1] This is one of a series of papers contributed by friends and former pupils of I. Seth Hirsch, M.D.

Physical signs are often revealing and yield significant clues as to the diagnosis. There is the ruddy bluish discoloration of the skin with the spleen enlarged, in about 75 per cent of the cases. In this series of eight cases, five patients had palpably enlarged spleens. The size varied, from one extending two fingers below the costal arch to one that was beyond the iliac crest. It was soft, smooth, and non-tender. In one case, B. G., a female 56 years of age, the large abdominal tumor (spleen) was the only symptom complained of. Hypertension is prone to be present, as is an increased basal metabolic rate. Patient W. K., 60-year-old male, complained of hypertension with marked compression in the chest. He also noted tiredness of his right leg associated with pain. Examination showed cardiac enlargement in both directions with marked dilatation of the aortic arch. His blood count showed 9,350,000 red blood cells.

By far the most decisive positive findings are to be gained from the study of the blood; it is dark and thick. Both the total blood volume and viscosity are increased and it is this increase which effects a widening in the lumina of the vascular tree and this, in turn, accounts for the usual symptomatology and physical signs. Total red cell counts may range from seven to ten million. In our series the lowest was 5.9 million and the highest 9.3 million on admission. Hemoglobin readings varied from 100 to 150 per cent. Not infrequently, elevation in the total white count appears in the peripheral blood with values in the range of 20,000 or more. Immature red cells are but rarely seen; more commonly, however, immature white cells may appear. Four patients in this series had white counts that were definitely elevated above the normal levels: B. G., 27,800; P. M., 38,600; W. K., 23,500; L. F., 21,100. But in no instance were there any immature white cells in the peripheral blood which would indicate or justify a concomitant myelogenous leukemia. The differential count was either normal or showed an increase in the neutrophils.

There have been cases reported of myelogenous leukemia and polycythemia vera appearing together. The leukocytosis and immature white cell production are due to the hyperplastic activity in the bone marrow in both the erythropoietic and leukopoietic centers.

Treatment.—Since polycythemia vera first was recognized as a clinical entity, numerous modes of treatment have been employed. Venesection, aside from its rather temporary amelioration, does not offer lasting benefit, and, moreover, may prove antagonistic, in that frequent blood withdrawal will stimulate new blood formation. Splenectomy has been essayed, but with negative results, and now is rarely advocated. Fowler's solution is employed in some clinics, but its end-results are uncertain and sometimes toxic. Phenylhydrazine hydrochloride, and more recently the acetyl derivative of the drug, have proven the most satisfactory medical agent heretofore employed. Its efficacy in reducing the total red blood-cell count has been clearly recognized, but its action is temporary and continues only as long as the drug is administered. Furthermore, its use is especially contra-indicated in arteriosclerotics and in bedridden patients.

Irradiation has definitely established itself as the best and most lasting method for the treatment of polycythemia vera. It is given with high voltage x-rays of 200 kv. potential with 0.5 mm. Cu plus 1 mm. aluminum filter at from 40 to 50 cm. distance with portals wide enough to cover the area to be treated. We recommend an individual dose of from 150 to 200 r (measured in air) repeated every third day. The superior sensitivity to the effects of x-rays of the ribs and sternum are well demonstrated in a review of the accompanying graphs.

Chart I illustrates a meager and short-lived response at the end of 20 weeks, when the tubular bones—the femora, tibiæ, and humeri—were irradiated. The count remained at an elevated level until the proc-

ess was altered and the ribs and sternum were treated. Soon thereafter the red count receded to within normal levels and persisted without the administration of further treatments. After about forty hydrazine hydrochloride was administered with rapid fall in the red cell count. Upon admission to the radiation therapy service, intensive doses of x-ray therapy were administered to the spleen, over a period

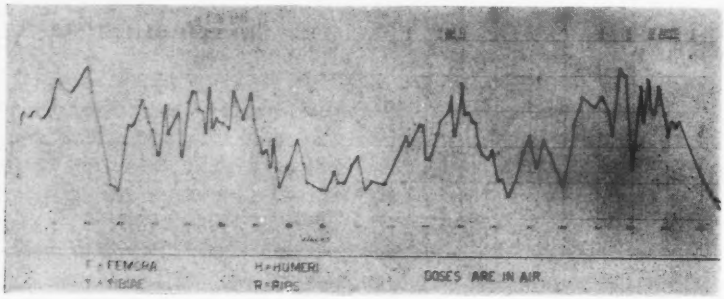

Chart I.

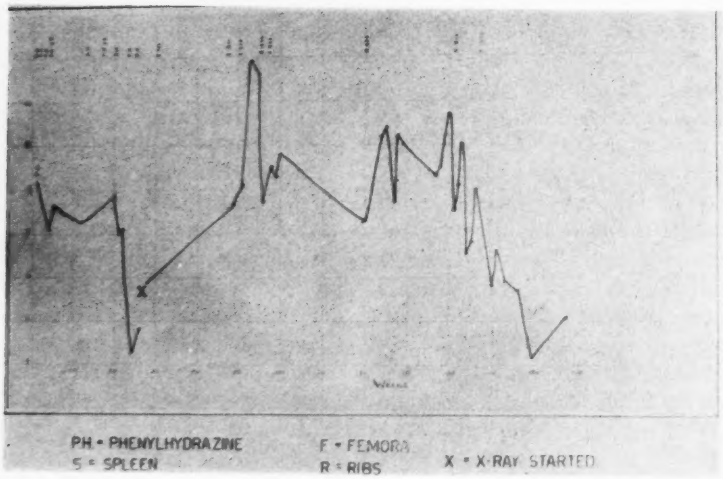

Chart II.

weeks, a new elevation began, at which time treatments were again delivered to the ribs and sternum and were followed by a rapid recession in the red cell level.

As contrasted with the long bones in relation to the ribs and sternum, Chart II compares the nature of response of the spleen with that of the ribs and sternum. During a period of 10 weeks while the patient was on the medical service, phenyl- of 20 weeks, but, in spite of these doses, the count continued to rise. When the red cell level was at its height, above ten million, the ribs and sternum were irradiated, with rapid and long-lasting response. At the end of 20 weeks, a slight rise was again satisfactorily controlled by irradiating the ribs and sternum. It was interesting to note that the splenomegaly persisted in spite of the fall in the red cells.

It is advisable to curtail treatments when the count begins to show a constant decline; furthermore, the level of the erythrocytes must be judged in relation to the symptomatology. In the absence of any uncomfortable symptoms, treatment need not be administered in the presence of a red cell count of six million, or thereabouts.

Prognosis.—Polycythemia vera, as contrasted to its hemopoietic sisters, the leukemias, need not be considered a fatal disease. C. H., a patient in the series, has been under our observation for eight years and is under satisfactory control. When patient B. G. came to the clinic, his spleen had been enlarged obviously for 12 years. These facts indicate that the disease is well established before symptoms appear. If to that is added the success of control that roentgen therapy can offer, it becomes apparent that these patients live for long periods with the illness. They die usually from cerebral hemorrhage or intercurrent infections at an age that parallels the incidence of the population.

CONCLUSION

Polycythemia vera is an uncommon disease. It may for a time be controlled by phenylhydrazine hydrochloride, but is more satisfactorily controlled by x-ray therapy. The best method is high voltage irradiation administered to the sternum and ribs.

55 East 86th Street

INTESTINAL MOVEMENTS IN THE ILEOCECAL REGION[1]

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From the Nuffield Institute for Medical Research, Oxford

IT is curious that while the intensive x-ray study of the pathology of the alimentary tract has, in the last 30 years, carried the subject from its experimental stage to something that is little short of an exact science, the study of the mechanical physiology, on which the interpretation of the pathology so largely depends, has lagged behind.

Gastric peristalsis was studied radiographically by Kaestle, Rieder, and Rosenthal (9), Cole (4), and Groedel (5) nearly thirty years ago, but at that time x-ray apparatus was feeble and fickle. Great credit is due to these early workers for the success they attained. Few, however, have attempted to unravel the more intricate movements of the food in the small intestine, which is the most important and active section of the alimentary tract as regards digestion. In fact, such a study has come within the region of possibility only since x-ray exposures for this class of work have been reduced to a fraction of a second. From the pylorus to the cecum, therefore, we know very little of the mechanics by which the food is influenced and propelled along its course. In this paper an attempt is made to describe the movements of the terminal ileum, which are clearly much slower and, in consequence, easier to analyze than those of the jejunum, which we hope to study later. I do not know of any systematic investigation of the movements that occur in the ileocecal region. Wingate Todd (12) in his studies only mentioned this section in passing and did not attempt to analyze the movements.

Very early in the days of the opaque meal, Case (3) and Hertz (6) independently described the gastro-ileac reflex, showing that when a patient took food there was a tendency for the terminal ileum to become active and empty its contents into the cecum. Shortly afterward, the writer (2) recorded a counterpart of this link, *i.e.*, the ileo-pyloric reflex: when the terminal ileum was loaded and did not empty into the cecum, food was retained in the stomach, the pylorus being reflexly controlled from the ileocecal region. He maintained that this accounted for the delay in emptying of the stomach that was so frequently noted in association with inflammatory lesions in the region of the ileocecal valve.

Whether there is a definite valve at the junction of the ileum with the cecum is a problem that a number of anatomists and radiologists have studied. Hunter (8) has worked on the anatomical side of the problem and holds that "the lower fold of the frenula coli acts as a valve to prevent the regurgitation of food material from cecum to ileum, and by thus raising the intra-cecal pressure aids in the opening of the ceco-colic sphincter, which in the human subject is incorporated within the frenula coli." He further suggests that "this valve-like action depends on the position of the terminal portion of the ileum; when the ileum ascends from the pelvis along the medial wall of the cecum, the flap acts as a valve, but when it is raised in the 'horse-neck' curve, the valve-like action does not occur. It is in this position that the ileocecal sphincter opens and permits the passage of food from ileum to cecum." Hirsch (7) published a detailed study in which he stated his belief in the existence of a functional valve in this position. Incidentally, he also claimed to have found evidence of a sphincteric tract in the ascending colon, analogous to that found in certain mammalia, but his illustrations are not convincing to me.

[1] This is one of a series of papers contributed by friends and former pupils of I. Seth Hirsch, M.D.

On the surgical side, Kellogg (10) was so sure of the functional importance of the ileocecal valve and of the ill effects of its incompetence, as determined by the backward flow from an enema into the small intestine, that he devised an operation for infolding the terminal ileum into the cecum, thus forming a valvular structure on anatomical lines. My own belief in the importance of this "radiological" incompetence was shattered in one of my first cases, when, although the enema had flowed very freely into the small intestine, at operation, the surgeon, attempting to milk the cecal contents into the ileum, found that nothing could be made to pass back into the ileum. In fact, experience at this and other operations seemed to indicate that it was a matter of chance whether or not the cecal contents could be made to pass back into the ileum.

With extended use of the opaque enema, radiologists found that they could frequently make some of it pass into the small intestine. Weber (11), in his work on this part of the alimentary canal, depends almost entirely on this procedure and succeeds in visualizing the small intestine in a very large proportion of cases. It seems, therefore, that although there may be no definite anatomical sphincter at the termination of the ileum, yet, as in the case of the cardiac orifice, a definite sphincteric action may occur, although it is not a constant feature.

The observations on which this paper is based are drawn from records made with a direct x-ray cinematographic apparatus, built for me some years ago under a grant from the Medical Research Council. This apparatus was designed to take serial radiographs at variable speeds up to eight a second on long bands (100 feet) of x-ray film five inches wide, each picture being five inches square. Many technical difficulties in the operation of this apparatus had to be overcome before satisfactory results were obtained, but the machine is now working well at a rate of up to three radiographs a second, a speed which we hope shortly to be able to double by the use of a contactor that operates more rapidly. The generating plant used in conjunction with this apparatus is a single valve unit, and up to the present time the minimum possible exposure for each radiograph has been one-tenth second. We employ a 10 kw. tube of ordinary type, having a focal spot of 4.1 × 4.1. Under the conditions of our work the exposure to the skin for each radiograph is 1.4 r.

The serial radiographs obtained with this apparatus have been reproduced on 16 mm. film, each radiograph being printed on five successive frames when the originals were made at the rate of three a second, and on eight when they were made at a rate of two a second. Thus, actual speed is reproduced when the 16 mm. film is projected at a rate of 16 frames a second. The movements of the viscera are well shown on the screen and are less jerky than one would expect from this technic. They can also be analyzed on the original films by means of tracings, on which the progress of the contractions of the intestinal walls can readily be followed. In these two ways it is possible to obtain a fairly accurate idea of the mechanics involved.

The subjects of investigation have been laboratory assistants and students, and the time of study has varied with the filling of the cecum. This has ranged from three to four and a half hours after the opaque medium (bismuth carbonate in water) had been given. Use was made of the gastro-ileac reflex in all cases, *i.e.*, a cup of hot tea was drunk either when the subject was positioned or just before, in order to stimulate the movements. Without this it is likely that many of our records would have shown no change in outline, and, in fact, even with this technic, appreciable movement is sometimes absent. Respiratory movements were eliminated as far as possible by compression, and in most cases also the subject held his breath during the period of recording.

In the course of routine work, the radiologist usually palpates the cecum and terminal ileum, but it is seldom that anything in the nature of definite peristalsis

Fig. 1. Fig. 2. Fig. 3.

(*See legends on opposite page*)

is noted on the fluorescent screen. For the most part the terminal ileum appears to be quiescent, but many workers have probably noted occasional rush movements of the shadow from this part into the cecum. These movements are, however, usually too rapid and unexpected for accurate observation.

In view of the fact that the movements of the terminal ileum are generally so slow that they are almost unobservable on the fluorescent screen, the first case was recorded at a slow rate, *i.e.*, one radiograph every three seconds. Unfortunately, it so happened that in this instance, during the period of recording, an exceedingly active phase of movement was in progress, a rush movement, in which peristaltic waves propelled the ileal contents rapidly into the cecum (Fig. 4). Our rate of recording was, therefore, far too slow. Consequently, in our subsequent experiments we employed a rate of either two or three radiographs a second, but we have not again been fortunate enough to obtain a record of such a satisfactory emptying of the terminal ileum.

The movements of the ileum recorded on our films vary somewhat in character according to the site in which they occur. In general, they appear to be due to contractions of the muscular wall of the gut and not to the action of the muscularis mucosæ. It would be of interest to know whether the muscularis mucosæ is less well developed in this region, as compared with that of the duodenum and jejunum, in which, in all probability, we shall find that this structure is largely responsible for the shredding of the food and its onward passage.

Many of the movements recorded in our x-ray films may be seen in the ordinary cinematographic film of the exposed intestine of the cat and rabbit, made by Alvarez and Zimmermann (1). A careful study of this film has been of much value in deducing the type of muscular contraction that causes the changes in the shape of the contents as shown in our x-ray records.

Ileum.—Movements of the gut a little distance (perhaps from 8 to 12 inches) back from the ileocecal "valve" are well shown in some of the records (Fig. 1). These appear to be of a more or less peristaltic type, the contents being propelled through some inches of the gut by the passage of powerful contracting rings which move either forward or backward, for it seems that in this section peristaltic waves pass freely in either direction, driving the contents back and forth and inevitably churning and compressing them. The compression may well be an adjuvant to absorption. As in the terminal portion of the ileum, non-propulsive contractions may be superimposed. An example of this is seen in Figure 1, in which the non-propulsive contraction remains stationary while the propulsive contraction overtakes it.

Terminal Ileum.—The occurrence of changes in the outline of the terminal ileum is not constant and there may be long periods in which practically no alterations are observable in the shadows. The movements that have been recorded fall under two heads: (*a*) Those that are concerned with the churning of the contents and are non-propulsive, and (*b*) those that are chiefly propulsive in character.

(*a*) Ring contractions of peristaltic type

Fig. 1. Consecutive frames of a film taken at the rate of three frames a second. The cecum is as yet only partially filled with opaque food. Note (1) the progress of a peristaltic wave (in the lower right-hand corner) preceded by a preliminary contraction that is stationary and is overtaken by the true peristaltic wave; (2) a small contraction in the terminal ileum, in which, however, very little change is seen; (3) the rugæ, running more or less parallel through the ileocecal "valve."

Fig. 2. Alternate frames of a film taken at the rate of three frames a second, showing part of the progress of a non-propulsive ring contraction in the terminal ileum, which moved forward about one and one-half inches and then returned and faded out.

Fig. 3. Consecutive frames of a film taken at the rate of two frames a second. The cecum is as yet only partially filled with opaque food. A large non-propulsive contraction is seen about four inches from the ileocecal "valve," moving backward.

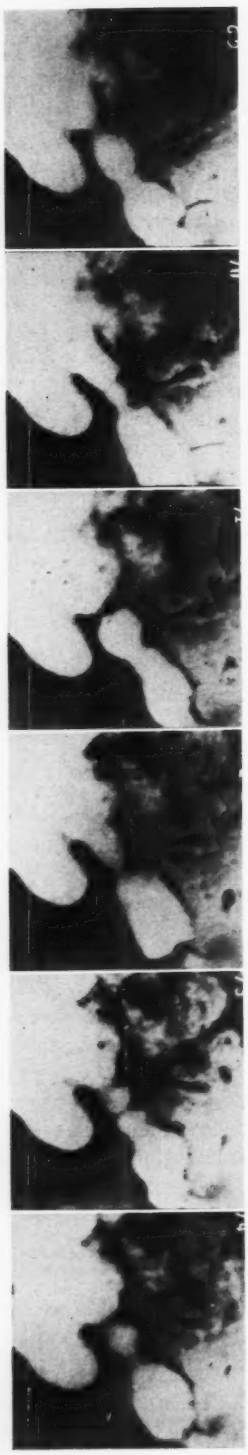

Fig. 4.

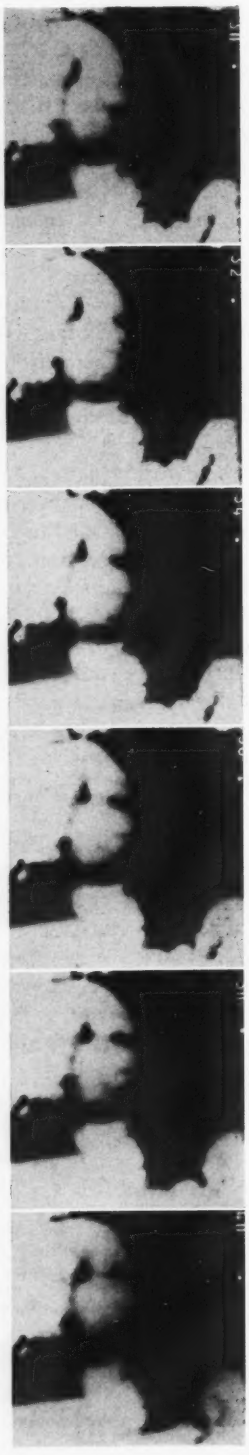

Fig. 5.

Fig. 6

(*See legends on opposite page*)

cut into the shadow of the contents of the terminal ileum (Figs. 2 and 3). These contractions appear to be due to the action of the circular fibers. Usually they take a few seconds to develop and, meanwhile, slowly travel perhaps two inches, either toward or away from the ileocecal "valve." Although they look propulsive in character, they do not propel the food to any extent in either direction. They fade out or return on their course and leave the general picture unchanged.

Pendulum movements have been described, and these are also noted in our records. They seem to be due to the lengthening and shortening of sections of the gut, *i.e.*, to contractions and relaxations of the longitudinal fibers. For instance, the contents of the terminal ileum appear to sway slowly laterally. On analysis of two of the films, we find that this swaying is due to a lengthening of the last few inches of the ileum, which, therefore, swings away from or toward the relatively immobile cecum. It does not appear that such movements are of importance in the mechanics of digestion.

(*b*) At times deep peristaltic contractions cause rush movements that carry the ileal contents into the cecum. Most observers have seen these occur, but the changes are usually too rapid and unexpected for the eye to note exactly what happens. As already mentioned, in the first case we recorded, one of these rush movements was actually taking place, but as we had expected to find only slow movements, our exposures were made at a rate of one in three seconds, with the result that we obtained only intermittent pictures of a movement that should have been recorded as fast as possible (Fig. 4). In another case (Figs. 5 and 6), however, the food was passing into the cecum in large quantity, but comparatively slowly, so that our record, taken at a rate of three radiographs a second and extending over a period of 15 seconds, covered only part of a slow rush movement that might well have emptied the whole of the contents of the terminal ileum. Apparently, both rapid and slow rush movements may occur.

The contractions that produce these rush movements appear to be of the same character as those that do not propel but only churn the food. In some instances it seems as if these latter suddenly respond to some impulse and become propulsive. This may be due to a change in co-ordination, as is suggested in some of the records. When a non-propulsive contraction progresses in an outlined section, the gut in front of it dilates to accommodate the increased quantity (in the same way that an inflated rubber bag distends elsewhere when pressure is applied at one point), but the column as a whole is not displaced. When, however, the contraction is propulsive, the dilatation in front does not occur, with the result that the contents are propelled onward. In this action the longitudinal fibers may also play a part.

Ileocecal "Valve."—In some of our records the "valve" is wide open and filled (Figs. 5 and 6), and the contents of the ileum are continuous with those of the cecum. In others, as in Figure 1, rugæ are seen in the position of the "valve," giving the impression of two or more small parallel channels entering the cecum. This appearance suggests that at the time of the exposures the "valve" is open but empty, for the rugæ do not converge as they would

Fig. 4. Consecutive frames of a film taken at the rate of one frame in three seconds, showing a rapid rush movement in the terminal ileum, propelling the food into the cecum. The time interval between each two frames is too long for the progress of individual waves to be traced.

Fig. 5. Consecutive frames of a film taken at the rate of three frames a second. The appendix is partially filled, but does not show any movement. Two non-propulsive contractions are seen in the terminal ileum, near the ileocecal "valve," while a slowly progressive propulsive ring contraction forms and comes up from below. This last contraction, however, is not forcibly propulsive at this stage.

Fig. 6. Alternate frames from a later stage in the same film as that illustrated in Figure 5, taken at a rate of three frames a second. The propulsive ring contraction seen beginning to form in Figure 5 is progressing slowly, and is now apparently propelling the contents into the cecum. A little higher up in the terminal ileum a ring contraction forms, but does not progress.

to a closed valve, as, however, they do in Figure 2. In this case (Fig. 2), the "valve" is apparently contracted, for the rugæ converge from either side on a point which is presumably the site of the "valve."

Cecum.—In our records alterations are seen to take place in the haustra. These are usually very slow and sometimes no change occurs over long periods. Another movement, however, can be detected, *i.e.*, a very slow general contraction and relaxation of the cecum as a whole. This mechanism is not shown in the illustrations, as the period covered is not sufficiently long. Evidence that such changes are in progress can, however, be detected. In a record made some years ago, this systole and diastole is quite definite and would seem to indicate a mechanism in the nature of a pumping action, designed to propel the cecal contents into the colon. Possibly the sphincteric tract that Hirsch (7) believes to be present in the ascending colon may work in conjunction with this mechanism. The movements of the cecum will be studied in detail, and reported in a later paper, together with those of the colon.

SUMMARY

By means of direct x-ray cinematography the movements of the terminal ileum and the action of the ileocecal "valve" have been studied.

Activity in this region is stimulated by the taking of food (gastro-ileac reflex).

Two main types of contraction are noted: propulsive and non-propulsive or churning. The latter are for the most part slow, while the propulsive contractions that empty the terminal ileum are usually rapid "rush movements." Relatively slow contractions of the same type have also been recorded.

The ileocecal "valve" does not, in our records, appear to act in a valvular manner to prevent the passage of food. Although capable of contraction, it is seen in the records to be both wide open and empty, and also wide open and full, with no sign of narrowing. In no case did we see any indication of ileal contents being pressed up against it—as is seen at the pylorus—and we have the impression that it exerted little influence on the passage of food during the periods of our records. It is, however, likely that in the presence of inflammatory conditions it may exert a valvular action, as is indicated by the delay that is noted in this region in appendicular trouble.

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RADIOLOGY IN THE TEACHING OF ANATOMY[1]

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THE progress made by radiology in the examination of the human body has led to its increasing use in the diagnosis of disease, so that to-day every general practitioner must have some knowledge of the normal radiographic appearances of the body if he is to understand the meaning of the radiologist's report. The time has passed when it was sufficient only to read the report, as was so prevalent some years ago, without understanding, from an examination of the film, the reasoning on which the report was based. In the final qualifying examinations it has been the custom now for many years to examine candidates on the appearances shown by radiographs of pathological conditions. The clinical examiner has already recognized that radiological appearances are playing an ever-increasing part in the detection, study, and control of many diseases. It entitles him to expect from the candidate for examination a fair knowledge of radiological diagnosis, much in the way as a knowledge of morbid histology is expected from students in every qualifying examination. In many schools there has been no attempt to teach the student the appearances of the normal radiograph, so that he has attempted to learn the interpretation of radiographs of pathological conditions while he has had only a very superficial knowledge of the normal. It is plain that any attempt to teach students the meaning of radiographs showing abnormal conditions without first teaching them to interpret radiographs of the normal is like trying to teach morbid histology without having first a knowledge of normal histology. To remedy this, the Board of Examiners for Anatomical Study of the University of London, in April, 1938, decided that students presenting themselves for examination in anatomy must show some knowledge of the radiological appearance of the human body. As a result, the teaching of radiological anatomy, which had been in progress only at certain schools for a number of years, has now become general.

The radiological teaching in most schools is carried out by a radiologist appointed as demonstrator of normal radiology to the department of anatomy. It is necessary that a radiologist should carry out the teaching of radiology in close co-operation with the teachers of anatomy, because in most cases the demonstrator of anatomy has not the necessary technical knowledge. Radioscopy, in particular, should be carried out only by a radiologist, because of the injuries which may occur from overexposure to x-rays by inexperienced operators.

The teaching of normal radiology in the anatomy department, as well as making the subsequent teaching of radiographs of pathological conditions easier, also exerts a favorable influence on the student's approach to his anatomical studies. In particular, radiological anatomy lays stress on the distinctive features of the living subject as contrasted with the cadaver, and attempts to bridge the gap between the cadaver (which the student must dissect in order to understand the mechanism of the body) and the living body. By the teaching of radiological anatomy, the student quickly realizes that the human body can show wide variations and yet come within the recognized normal limits. Radiological anatomy, perhaps more than any other subject, draws attention to the wide variations which exist between normal individuals and the differences which may exist in the same subject under differ-

[1] This is one of a series of papers contributed by friends and former pupils of I. Seth Hirsch, M.D.

ent conditions and at different times. Emphasis must be laid on the importance of being able to co-ordinate radiological appearances with those features of the body which can be determined by external examination and those details which can be learned only by dissection.

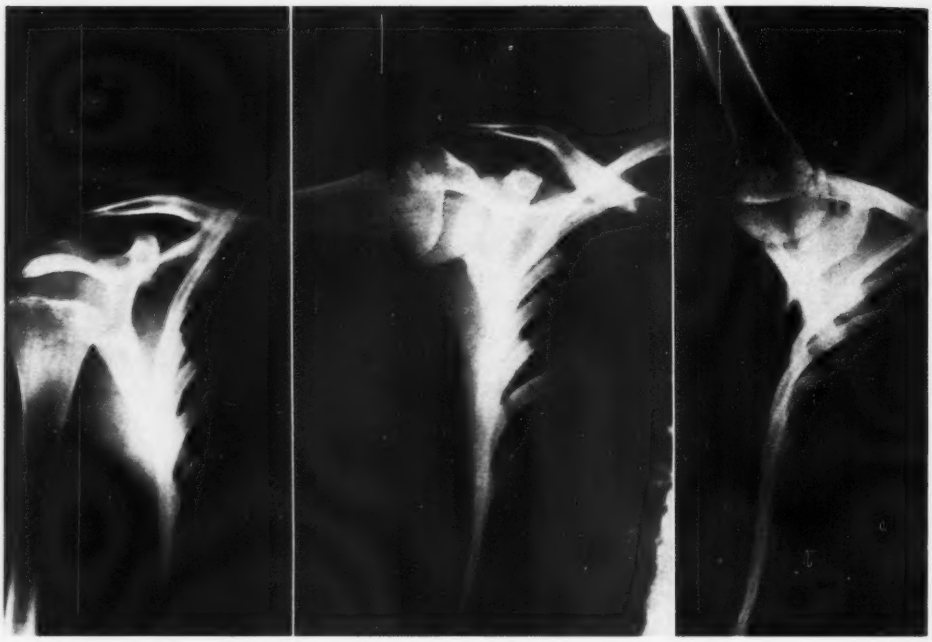


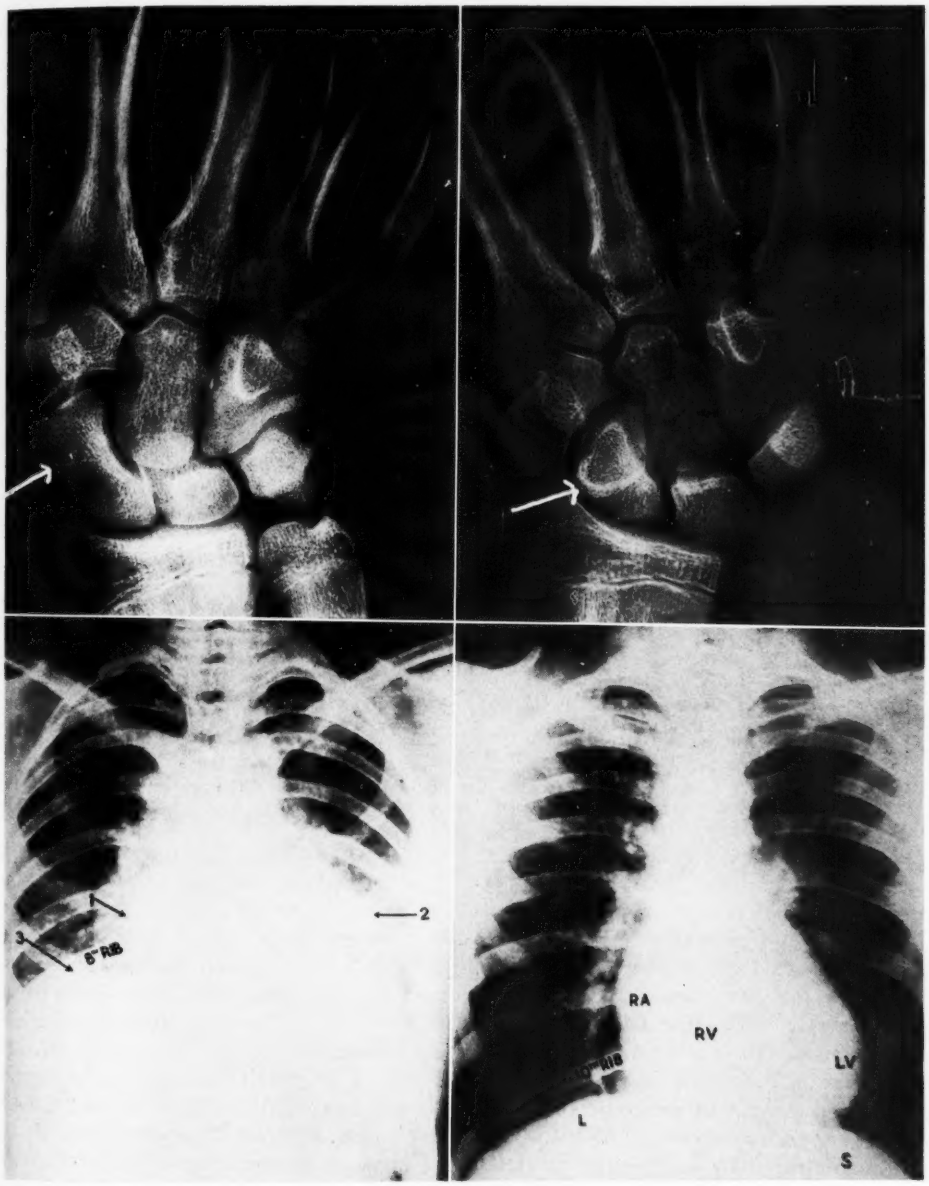
Fig. 1. Fig. 2 Fig. 3.

Figs. 1, 2, and 3. Movements of the shoulder girdle. Fig. 1. Position with the arm in adduction. Fig. 2. Position with the arm in 90-degree abduction. The movement takes place between the humerus and scapula. Fig. 3. Position with the arm at 180-degree abduction. Further movement has taken place by forward rotation of the scapula on the thorax.

The student rarely dissects any part of the body more than once, and it is a well-known fact that the average medical practitioner remembers very little of the detailed anatomical teaching which he acquires with so much labor. The effect of introducing the teaching of radiology into the study of anatomy has been rewarded by the increased interest which the student takes in the subject. By learning his radiological anatomy at the same time that he carries out his dissection, he is given a fuller understanding of many of the structures under dissection. He realizes that in hospital and private practice he is going to be faced again and again with radiographs, and that the dissection he carries out on the cadaver amplifies and explains what he can see in the radiograph.

The method by which radiological investigation helps anatomical teaching is seen in the study of the development of the epiphyses. A knowledge of the times of appearance and dates of fusion of the epiphyses with the diaphyses has always been expected of every student in examinations in anatomy. The importance of such knowledge is purely academic unless the student is able to apply this knowledge when he is qualified. By studying radiographs showing the stages in the development of the epiphyses and their fusion, the student learns not only the times of appearance and dates of fusion of the epiphyses, but also their radiographic appearances

and variations. This is necessary because, at a later stage in his career, he will have to differentiate between an epiphyseal line and a fracture, and he will more rapidly learn to detect separation of the epiphyses. In the elbow joint in particular, the ap-



Figs. 4 and 5 (*above*). Movements of the scaphoid as seen on the radiograph. Fig. 4. In ulnar deviation, the full length of the scaphoid is seen. Fig. 5. In radial deviation, the scaphoid has rotated so that the proximal part of the bone is rotated backward and the distal part forward.

Figs. 6 and 7 (*below*). Effect of respiration on the position of heart and diaphragm. These two radiographs show the changes in the level of the diaphragm in full expiration and full inspiration. The heart is displaced upward by the upward movement of the diaphragm and becomes more transverse in type.

pearance of the epiphyses in their various stages of development can more easily be learned by the student from suitable radiographs than from dissections. The extra ossicles in the hand and foot, which, because of their inconsistency and wide variations cannot be learned easily by dissection, are rapidly learned from radiographs. Though in the hand and foot the extra ossicles rarely give rise to pathological lesions, yet in the knee, if the position of the flabella in the head of gastrocnemius is not appreciated from anatomical dissection, it may be mistaken at a later date by the student for a loose body in the knee joint.

The examination of the movements of joints in anatomical teaching can best be seen by radioscopy and serial radiographs showing the different stages composing the movements. In this way the student acquires a better understanding of the parts played by the bones in limiting the joint movement and the relation of one bone to another during the movement. The importance of radiographs in the examination of the mechanism of joint movement is well illustrated in the shoulder. The movements of the arm from the position of rest at the side of the body to above the head by abduction is a compound movement. Figure 1 shows the familiar radiograph of the shoulder girdle with the arm at the subject's side. Figure 2 shows that with 90° abduction the movement takes place between humerus and scapula. With further abduction to 180°, the scapula is rotated and glides laterally and forward on the thorax. The lateral and rotatory movements are expected, but the forward movement can

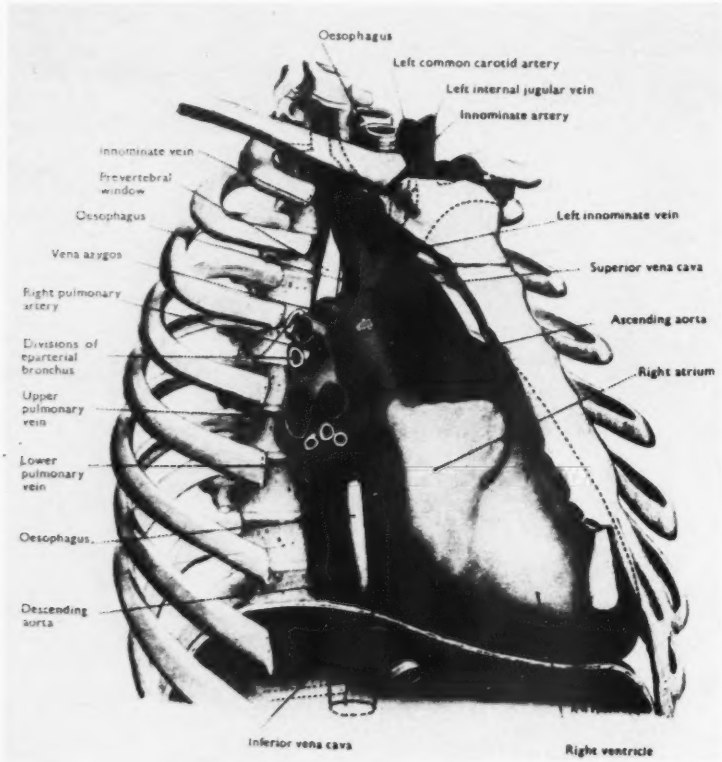


Fig. 8. Special dissection to show the anatomical relations of the prevertebral window and retrocardiac space as seen in the oblique position.

be appreciated only from radiographs and is not described in many anatomical textbooks. The glenoid fossa in Figure 3 is

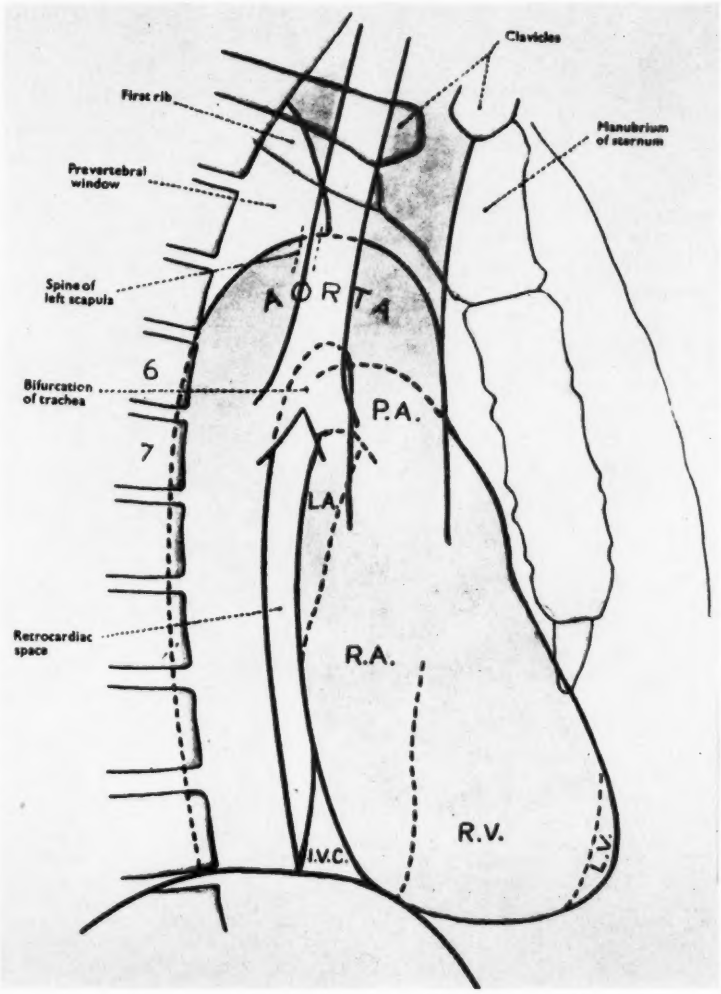


Fig. 9. Radiographic key to Figure 8.

directed upward and forward; the coracoid process is seen behind the clavicle, so that the coracoclavicular ligament has been rotated backward.

In a similar way, the complicated movements of the scaphoid bone in the hand can best be visualized by radiographs. Figure 4 shows the hand in ulnar deviation. The long axis of the scaphoid is seen to lie in the long axis of the radius. Figure 5 shows the hand in radial deviation. The scaphoid has now rotated through its transverse axis so that its proximal part is rotated dorsalward (backward) and the distal part ventrally (forward). In passing, it should be noted that fractures of the scaphoid are best seen with the hand in ulnar deviation, as in this position the full length of the bone may be seen in the postero-anterior radiograph.

A sound knowledge of the radiological

anatomy of the chest and abdomen is essential to the student carrying out anatomical dissection of these parts. It is in fixed level. The right dome of the diaphragm is stated to be on a level with the lower part of the fourth right interspace,

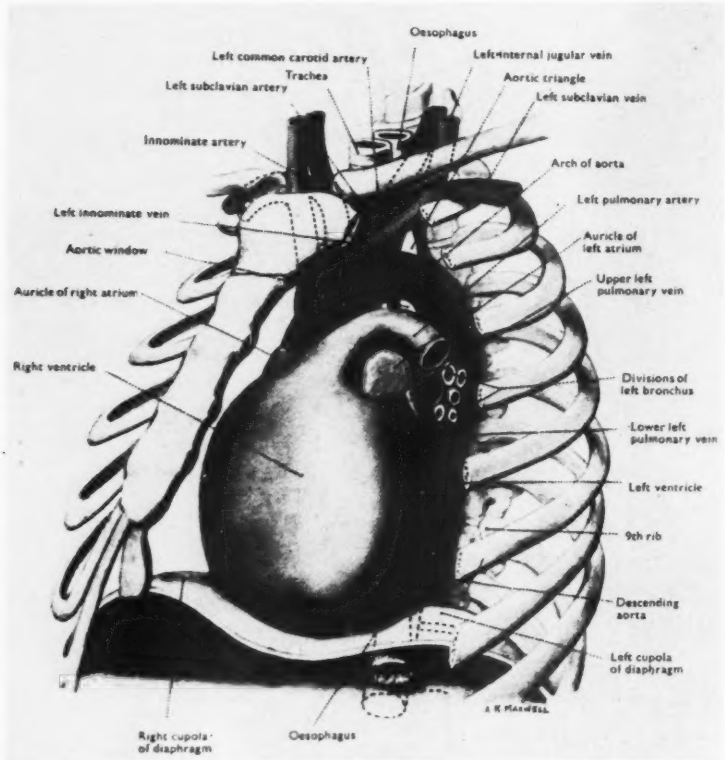


Fig. 10. Similar dissection to Figure 8, showing the relations of the aortic triangle and aortic window.

these regions that radiological study has brought about many revisions in the anatomist's ideas. Much of the anatomy of surface markings of these areas, which was compiled for the most part from the cadaver, has been re-written in the light of information obtainable by radiological methods. The teaching of the cadaver surface markings as applied to the organs of the chest and abdomen is, in the light of radiological teaching, no longer justified if the facts so learned are to be applied to the living subject. The surface marking of the diaphragm in the cadaver is given by Rawlings "Landmarks and Surface Markings of the Human Body" as a definite while the left dome is opposite the lower part of the fifth left rib and costal cartilage. The choice of such landmarks for the position of the diaphragm is not applicable to the living subject because of their inconsistency. The anterior parts of the ribs rise upward on inspiration as the diaphragm descends. A better landmark is the level of the diaphragm in relation to the vertebral column. Radiological examination shows that any table of levels for the diaphragm is modified by whether the patient is in the erect or prone position. Table I gives the level of the diaphragm as seen by a series of teleradiographic films taken in the erect position.

In many anatomical text-books the surface markings of the position of the heart, and even the heart valves, are given in great detail. If the chest is examined by radioscopy or by radiographs taken at full inspiration and full expiration, it is seen that at full expiration the heart shadow is placed at a higher level and more transversely on expiration than on inspiration. (Compare Figs. 6[1] and 7.) It must be recognized that the usual surface markings of the heart as depicted on the anterior chest wall are inaccurate. Even percussion of the heart's outline is not of much value when it is realized that the radiograph of the chest gives much more exact detail as to the position of the borders of the heart.

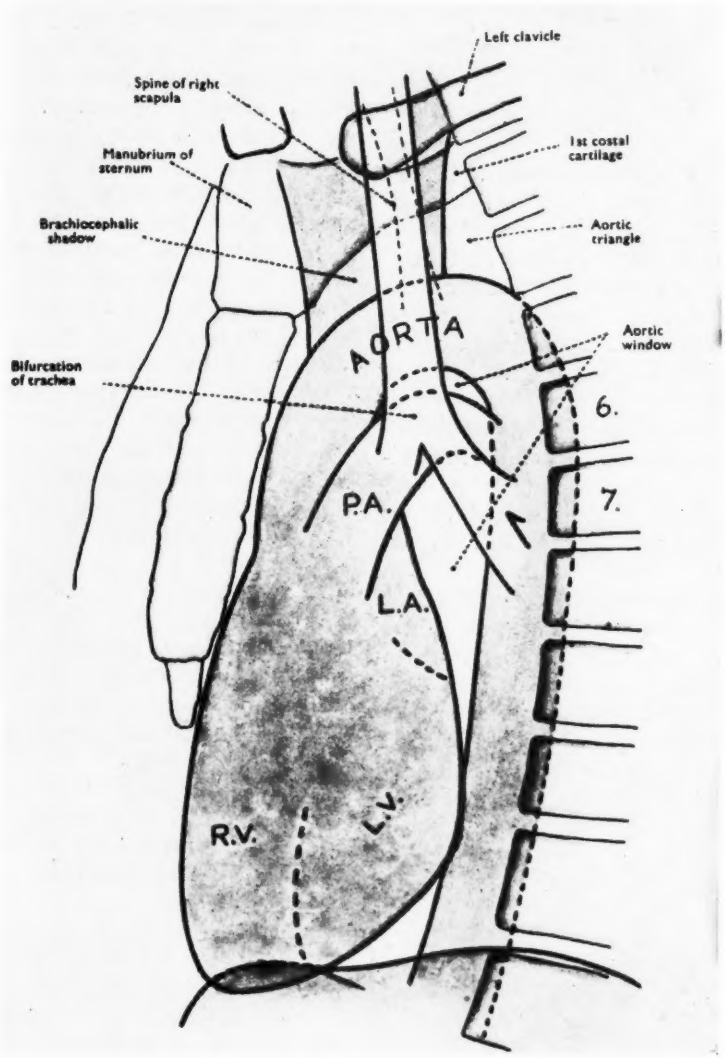


Fig. 11. Radiographic key to Figure 10.

The importance of the right and left

oblique chest radiographs, in the examination of the heart for lesions, makes it necessary that the special dissection of these parts should be considered. Figure 8 shows such a dissection, with the radiographic key (Fig. 9). It is very important that the student should know the relations forming the prevertebral window and retrocardiac space. Figure 10 shows the relations of the aortic triangle and aortic window. Figure 11 gives the radiographic key. This is in addition to the usual anatomical teaching and is of great cardiographic importance from a clinical standpoint.

TABLE I.—SHOWING UPPER LIMIT OF DIAPHRAGM[2]

Diaphragm	Right Dome	Left Dome
Full inspiration	Body of eleventh dorsal vertebra	Body of twelfth dorsal vertebra
Full expiration	Body of ninth dorsal vertebra	Body of tenth dorsal vertebra

The position of the abdominal organs shows such wide variations in the living, in the erect and prone positions, that a knowledge of their surface markings as gained from the cadaver is misleading since they are described as being at fixed points. The conventional anatomical surface markings of the position of the stomach as shown in anatomy text-books should be modified in the light of radiological findings. Such surface markings are of no help from a surgical standpoint and from a clinical examination point of view are practically valueless. The student studying the gastro-intestinal canal by means of radioscopy and radiographs quickly realizes that the position of these organs in the abdominal cavity depends on the degree of the distention and tone of the organ, and that their position is also influenced by the tone of surrounding tissues. Respiratory movements also vary the position of the abdominal organs. In the case of the stomach, the up-and-down movement may be as much as three inches. Gravity also plays a part in the position of the organs, which descend when the subject moves from the prone to the erect position. In the case of the ureter, its surface marking is given for the cadaver as a line drawn vertically from the level of the spinous process of the second lumbar vertebra to the posterior superior iliac spine. By excretion radiography, it can be shown that the ureter rarely occupies this position. It is sometimes seen to take a curved course and become bowed toward the center line as the kidneys move with respiration.

From the foregoing it is apparent that the introduction of radiology into anatomical teaching must modify and in some cases correct many ideas of anatomical teaching which are applicable only to the cadaver. The student's interest in dissecting the cadaver is to learn facts which he may be able to apply at a later date to patients. The use of radiology in teaching anatomy helps to bridge the gap between the living and the dead.

[2] Appleton, A. A., Hamilton, W. J., and Tchaperoff, I. C. C.: Surface and Radiological Anatomy. Cambridge, 1938.

MEGADUODENUM AND DUODENAL OBSTRUCTION[1]

CRITERIA FOR DIAGNOSIS

By MILLS STURTEVANT, M.D., *New York City*

MEGADUODENUM is said to have been described as early as the middle of the eighteenth century (1). It has taken a place in clinical medicine since roentgen study of the gastro-intestinal tract became a part of diagnostic procedure. The possibility of intermittent obstruction at the duodenojejunal angle has been recognized and a causal connection with megaduodenum has seemed demonstrable to some. It is the purpose of this paper to present a case of megaduodenum and to discuss the criteria for diagnosis of duodenal obstruction.

Case 1. A young girl, 18 years old, born in England, had lived with her parents in different countries where her father's business had taken them. He was a mining engineer and his work had not only required their living in different countries but also for periods, in out-of-the-way places where their choice of food was limited and living conditions otherwise primitive. The patient had a lateral curvature of the spine and had been subject to digestive upsets when she would vomit, complain of abdominal distress, and be incapacitated for short periods. After these attacks she would make rapid recovery. The attacks had been regarded rather indefinitely as "regular children's vomiting" and had become less frequent as time went on. Shortly before being seen, the patient had been operated on for her spinal deformity and an extensive plaster cast was applied, encasing her entire body. The day after the operation she began to vomit and continued to do so whenever she ate. In ten days she had lost as many pounds in weight.

The films shown in Figures 1 and 2 were made. A hole was cut in the cast and the ascending colon was lifted, with the hand inserted in the hole thus made. Postural treatment was suggested, with the patient lying on her stomach and walking on her hands and knees. A liquid diet was given at first and then soft solids. A symptomatic recovery resulted almost immediately and this was continuous, after the cast could be removed.

Both megaduodenum and duodenal obstruction have been described at length and various views of a possible relationship have been expressed. The papers of Bockus (2) and Kellogg (3), and the monograph of Duval (4) give the history of the development of knowledge concerning the two conditions and give extensive bibliographies. Duodenal obstruction has been described with pressure of peritoneal bands (5, 6) congenital and inflammatory, the latter secondary to peptic ulcer (7, 8), biliary and pancreatic infections, malignancy of the stomach or of neighboring organs, or the pressure of the newgrowth or other pressure from without, or obstructive pathology of the duodenum itself.

It has seemed to various duodenologists (10, 11, 12, 13, 14) that compression of the duodenum by the mesenteric artery in the root of the mesentery may furnish or help to furnish partial obstruction and that the very angularity of the gut is also a factor. Since an asthenic habitus would increase the angularity of the duodenojejunal loop and decrease in bodily fat would increase the tug of the mesentery and make the mesenteric artery more prominent and rope like, one would expect to find the condition more often in the asthenic and in fatigue and debilitated states. This is said to be the case. A weight of evidence in favor of such a condition, responsible for a symptom-complex accompanied by par-

[1] This is one of a series of papers contributed by friends and former pupils of I. Seth Hirsch, M.D.

Fig. 1.

Fig. 2.

Fig. 1. Megaduodenum.
Fig. 2. Megaduodenum. Six-hour film showing residue in the stomach, the cap, and at the bend of the duodenum.

oxysmal vomiting, sometimes pain, and sometimes severe headache (15), is considerable. The monograph of Duval (4) discusses the anatomy and pathology at length.

It would seem that, with dilatation of the duodenum and delay, one had roentgen evidence of obstruction, yet this has been denied by some. Downes (16), who observed a case in a child, regarded the enlarged duodenum as similar to the enlarged colon in megacolon. Duval (17) has held a similar view. Certain students (18, 19, 20, 21) of upper abdominal symptoms have thought that actual mechanical obstruction was not necessary and that the condition might be due partly, or wholly at times, or even always (21), to functional obstruction, part of an autonomic phenomenon, with central factors, variously described by different authors as "emotional states," "nervous impressions," or "hysterical conditions."

Roentgen criteria for diagnosis have been suggested. These have consisted of the following: duodenal antiperistalsis, duodenal stasis, violent duodenal peristalsis, the "writhing duodenum," and "full-filling" of the duodenal cap. To these there might be given some study.

Jordan (22), in 1923, described the distended duodenum struggling to expel its contents, "writhing energetically in futile effort," and Wheelon (23) has published a study supporting this view. That this means obstruction at the duodenojejunal angle has been disputed by Case (24) and others who have found the writhing duodenum in supine position, with rapid emptying of the stomach, and as a transient phenomenon without demonstrable cause. Bloom and Arens (25), in 1927, published a study of 200 cases showing duodenal stasis, 50 of whom were operated on. In all but 10 of the patients in this series, an irritative focus was found near. Gall-bladder disease, duodenal ulcer, and appendicitis were the most frequently associated diseases. These writers state that chronic duodenal ileus due to mechanical obstruction is rare. They regard antiperistalsis, writhing duodenum, and duodenal delay as roentgen signs of other pathology. Usually the contrast meal can be seen to enter the duodenum and when it reaches the second or descending portion it becomes split up into small amounts. This is caused by the valvulæ conniventes and is sometimes called feathering. If the duodenum is distended or dilated, it becomes filled by the contrast material and the feathering is not seen but the shadow

Fig. 3.

Fig. 4.

Fig. 3. This duodenum shows "full-filling." It was also said to show writhing, antiperistalsis, and regurgitation.
Fig. 4. Showing duodenal filling with very little history of upper abdominal disturbance.

is solid and homogeneous. This "full-filling," at the bend of the duodenum between the descending and ascending loops, sometimes called the knee, has been regarded (26) as pathognomonic of duodenal compression.

When diagnostic criteria are vague and not always dependable, the condition to which they are supposed to point may become a diagnostic refuge for any atypical or ill-defined symptoms for which we are at a loss for an explanation. Films of two additional cases are given here, selected from a number of cases in which the diagnosis of obstruction at the angle of Treitz was made but in which the diagnosis was at least incomplete and detrimental to the patient.

Case 2. This patient, treated for a productive osteo-arthritis of her hands, was given cinchophen over a long period. She developed dyspeptic symptoms and although she was 57 years old and had never had gastro-intestinal trouble, the diagnosis of duodenal obstruction was made and postural exercises and a fluid diet advised (Fig. 3). She shortly became jaundiced and her liver necrosis brought out the fact of her medication. The cinchophen was stopped; she recovered and her dyspepsia was gone.

Case 3. A man, 34 years old, had always been well until six months before when he became very constipated. His movements were bloody. He was told he had hemorrhoids and was given a salve. After two or three months, his constipation gave way to diarrhea with mucus and blood. There was considerable urgency but movements were, at worst, only six or eight a day. His film showed some dilatation of his duodenum which brought out the history of vomiting at long intervals, over the last 15 years. He thought it had usually been when he had eaten unwisely, but his diagnosis became duodenal obstruction. After some time, money, and effort were lost, a proctological examination showed the presence of an ulcerative colitis. In two years he has had no vomiting and no other upper abdominal dyspepsia, showing that it is possible to show not

only a "full-filling" but also some duodenal dilatation with few or no symptoms (Fig. 4).

It is not the purpose of this paper to deny the existence of arteriomesenteric compression of the duodenum. The author believes that duodenal obstruction is a definite entity. It is, however, suggested that such a disease is seen but rarely in a large charity hospital in New York City, and that the roentgen criteria which have been suggested for diagnosis are not always conclusive when present.

SUMMARY

A case of megaduodenum is presented. The roentgen signs supposedly pathognomonic of duodenal compression are discussed. It is suggested that these signs are not always associated with symptoms and that care should be used in accepting them.

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REDUCING THE TOXIC PERIOD IN HYPERTHYROIDISM[1]

By S. C. BARROW, M.D., *Shreveport, La.*

IN the discussion of any medical problem, clearness and definiteness in presenting the thought we wish to impress, as well as brevity and conciseness, are appreciated by all readers of medical literature, but seem to be overlooked by many writers. The kernels in many nuts go undetected because of the perambulations of those seeking to call them to our attention.

In the treatment of hyperthyroidism by x-rays, it has been our conviction for some years that the dosage given, even by those of wide experience, is insufficient for the best interests of the patient. This is the thought we wish to impress at this time. We will be brief and will attempt to be concise and clear.

For the purposes at hand, it is hardly necessary to call attention to the fact that the basic etiological factors in hyperthyroidism are not definitely known. Whether the thyroid gland solely is at fault, or whether its function is disturbed indirectly through extraneous influences, is likewise uncertain. These uncertainties should have great weight in determining the therapeusis in all cases of hyperthyroidism.

As the mysteries and intricacies of the ductless gland system unfold, it is well to bear in mind the possibility that there may be other functions of the thyroid gland than those now recognized, which in turn, may be factors in the proper coordination not only of the ductless gland system, but of physiological processes in general. Yet we do know that the surgical removal of the thyroid, or proper radiation of the gland alone, will restore the patient to normalcy. Hence, until further development, therapy addressed to the thyroid appears to be the proper procedure.

With these logical thoughts and facts before us, we are again impressed with the principle that no organ of the body should be removed because of dysfunction or excess function, when it is possible to correct its functioning processes. When there is present an excess function of an organ, the application of an agent which depresses this function is logical and scientific. The application of an agent which destroys an organ because of excess function, is illogical and unscientific. Thus is contrasted the background of surgical and roentgen therapy in hyperthyroidism. We shall not enter a discussion of x-ray *versus* surgical treatment of hyperthyroidism, neither a statistical presentation of the results of each: they are easily accessible and well known to those interested.

The depressant action of roentgen rays in all conditions characterized by hyperfunction or excess cell activity is recognized, and is borne out by experimental studies and clinical experience; likewise, the resistance of cells in normal activity to radiation is well known. The one and only argument deserving consideration which has been advanced against roentgen therapy for hyperthyroidism is the *time* usually consumed in bringing the patient to a non-toxic state.

Small dosage at long intervals seems to be the practice generally followed. Even those securing 90 per cent and upward of ultimate cures are consuming from six to nine or more months in the treatment of their cases. We all know what prolonged toxicity means in hyperthyroidism. The criticism advanced by our surgical confrères that we allow our patients to remain toxic too long, is, in many instances, a just criticism.

The object of the surgeon has been to abruptly and with one stroke remove the source of toxicity, the thyroid gland. It has not been argued or shown that the

[1] This is one of a series of papers contributed by the friends and former pupils of I. Seth Hirsch, M.D.

abruptness of itself, in removing the toxicity, was deleterious to the patient. Why not, then, as abruptly and with as few strokes as possible, suppress this toxicity by radiation?

CHART I

1936	Pul.	Trem.	Exo.	Enl.	Wt.	Met.	Rad.	Med.
6/13	130	3+	0	2+	98	+44	1200r	Quin.
6/20	110	2+	0	2+	96	+37	800	"
6/27	110	2+	0	1+	97	+30	600	"
7/4	100	1+	0	1+	95	+30	800	"
7/18	90	1+	0	1	96	+28	600	"
8/1	100	1+	0	1	95	+30	600	"
8/15	100	1+	0	1	98	+32	600	"
8/31	80	0	0	0	103	+1	0	0
10/8	80	0	0	0	113	+1	0	0

200 kv., 0.5 mm. Cu, 2 ant. lat., 1 pos. port.

Following the use of comparatively large doses of x-rays in extremely toxic cases of hyperthyroidism, we have never seen any ill effects. On the contrary, by the application of rather intensive dosage we have seen only good results, the most toxic cases becoming non-toxic in from four to ten weeks, rather than in from six to nine months. By rather intensive dosage, we do not mean intensive as far as skin tolerance is concerned, but intensive compared to the usual dosage advised.

If the metabolic rate is running high, plus 50 or more, the application of 750 r weekly, dividing the dose over three areas, right and left anterior lateral and posterior, with a kilovoltage of about 130, 3 mm. Al filter, is the minimum dosage indicated. This may be repeated from six to eight times at seven-day intervals, with no ill effect on the skin. Checking the metabolic rate each week, these doses should be spaced at longer intervals or decreased as the metabolic rate falls. The metabolic rate should be reduced to zero before discontinuing treatment, else a rebound will inevitably follow.

The fear of myxedema following x-radiation is hardly to be considered when radiation is applied intelligently. Prolonged excess function of the thyroid cells is, in many cases, followed by cell exhaustion, regardless of what type of therapy has been used. Intense radiation given over the thyroid area in cases in which the thyroid is normal, has not shown any bad effects on the gland.

CHART II

1932	Pul.	Trem.	Exo.	Enl.	Wt.	Met.	Rad.	Med.
5/21	140	4+	2+	2+	85	+60	750r	Quin.
5/28	130	4+	2+	2+	85	+62	750	"
6/6	130	3+	2+	2+	87	+50	750	"
6/13	110	2+	2+	1+	87	+42	750	"
6/20	100	1	2	1+	92	+26	300	"
7/4	100	1	2	1+	96	+18	300	0
7/18	80	0	1+	1+	100	+10	0	0
8/8	80	0	1+	1	104	+5	0	0

130 kv., 2 mm. Al, 2 ant lat., 1 pos. port.

Under circumstances in which it is difficult because of distance or other causes to give weekly applications, still more intensive dosage may be applied at fourteen-day intervals (200 kv., 0.75 mm. Cu filtration, with 1,200 r distributed over three areas). This technic may likewise be repeated with safety, but will not require as many applications, because the metabolic rate falls rapidly.

In the treatment of all cases, foci of infection should be removed, iodine withheld, and quinine used liberally, with, of course, restrained activity as indicated.

The two charts here presented indicate the conditions existing in two typical cases of hyperthyroidism, with the treatment usually given, and the results usually obtained.

Case 1 (Chart I) was one of our most resistant cases, yet from June 13 to August 31, a period of ten weeks, it was noted she became toxic-free.

Case 2 (Chart II) illustrates a low voltage technic with one-week intervals in treatment, the patient becoming non-toxic in approximately seven weeks.

If radiation were applied regularly in cases of hyperthyroidism, in dosage needed, the one logical argument used against it would fall.

ROENTGEN-RAY TREATMENT OF SKIN CANCER[1]

By CHARLES W. PERKINS, M.D., *Norwalk, Connecticut*

CANCER of the skin usually begins in abnormal tissue, such as a wart fissure, old scar, thickened skin, and from prolonged irritation due to dirt, dust, or wind. It is frequently found in elderly patients whose skin is thickened and in those individuals who have led lives exposed to the weather, as well as in persons living in rural districts who seldom use warm water and soap for cleansing purposes. If these pre-cancerous lesions are cured, no carcinoma will develop. Cancer of the skin is very often ignored as it causes very little discomfort. It is an appalling fact that four thousand deaths occur in the United States each year from skin cancer. I have noted with surprise that in certain rural communities skin cancer is permitted

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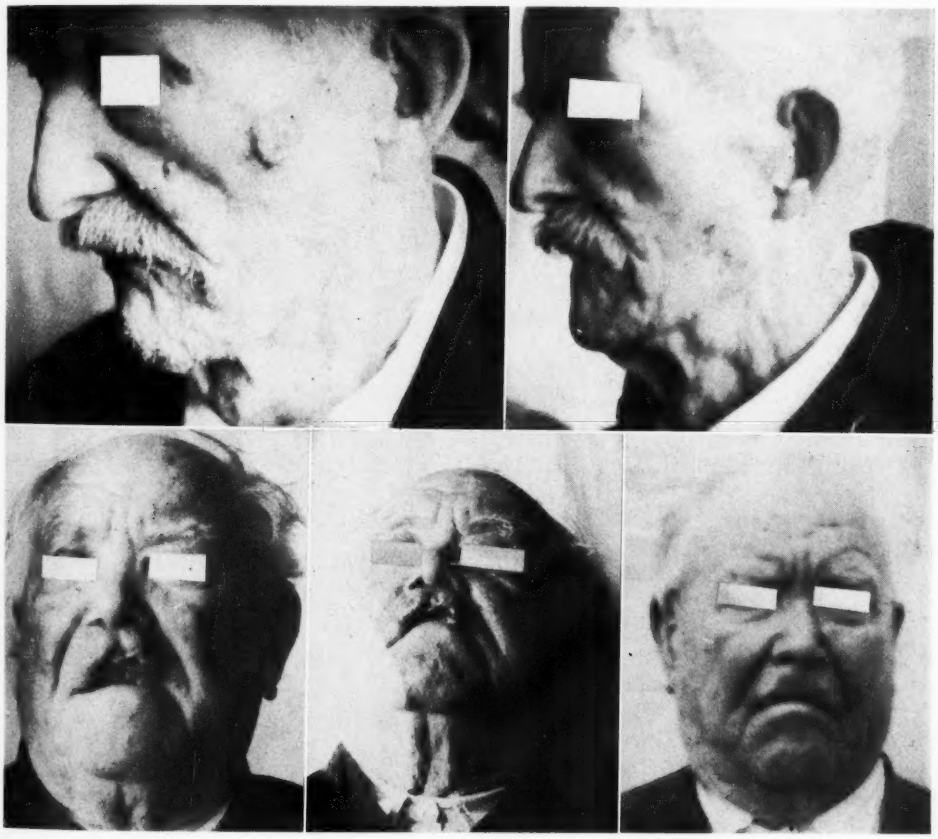

Fig. 1 (*above*). Mr. K., aged 79, Aug. 7, 1934, papilloma. Question of epithelioma, 2 cm. wide and 6 mm. high. Duration, six months. Treatment, 3,400 r units, unfiltered, within nine days. Healed perfectly by Sept. 21, 1934.

Fig. 2 (*below*). Mr. T., aged 85, April 4, 1938, epidermoid carcinoma, 5 cm. long and 3.5 cm. wide, ulcerated, one-year duration. Bad teeth. Heavy smoker; whole lip swollen, edematous. Treatment, 10,000 r units, unfiltered, within a week. Healed, June 6, 1938, with good cosmetic result.

to reach the advanced stage before medical aid is sought. This is partly due to ignorance on the part of the patient who does not realize the gravity of the condition. This type of patient will treat a skin lesion with ointments and salves. He has no way of knowing that the irritating effect of such treatment aggravates his lesion. A few years ago I saw a patient with one-half of his face eaten away with carcinoma before he even consulted a physician. The case was so far advanced that it was impossible to do anything for him. If such cases are treated early, from 95 to 98 per cent can be cured permanently.

Chronic irritation is recognized as probably the most important factor in the stimulation of abnormal cell growth. As the proliferation continues, the vitality of the part decreases and in the older center cells necroses and ulceration are produced.

Ninety per cent of skin cancers develop on the face, neck, and hands. Areas not protected by clothing are especially vulnerable. About two-thirds are basal-cell type and one-third are squamous-cell carcinoma.

Fig. 3 (*above*). Mr. C., aged 82, July 22, 1935, basal-cell carcinoma on ear, 1.5 cm. wide. Nine months' duration. Treatment, 6,000 r units, unfiltered, within seven days. Healed perfectly by Oct. 1, 1935. No return to date.

Fig. 4 (*below*). Harry V., aged 65, Feb. 9, 1935, basal-cell carcinoma, circumscribed ulcer, raised surface, bleeds easily, two and one-half years' duration. Treated with several kinds of applications without result. Treatment, 6,000 r units, unfiltered, given within one week. Healed by April 15, 1935. No return to date.

Basal-cell cancer usually occurs in persons beyond middle age. It may begin as a papillomatous lesion, the so-called rodent ulcer which is slow in destruction of the surrounding tissues. The characteristic lesion is ulcerative, with a raised pearly border, and is common on the face, especially above the lip line. However, it may occur on the neck, arms, back, chest, legs, buttocks, and perineum. Basal-cell can-

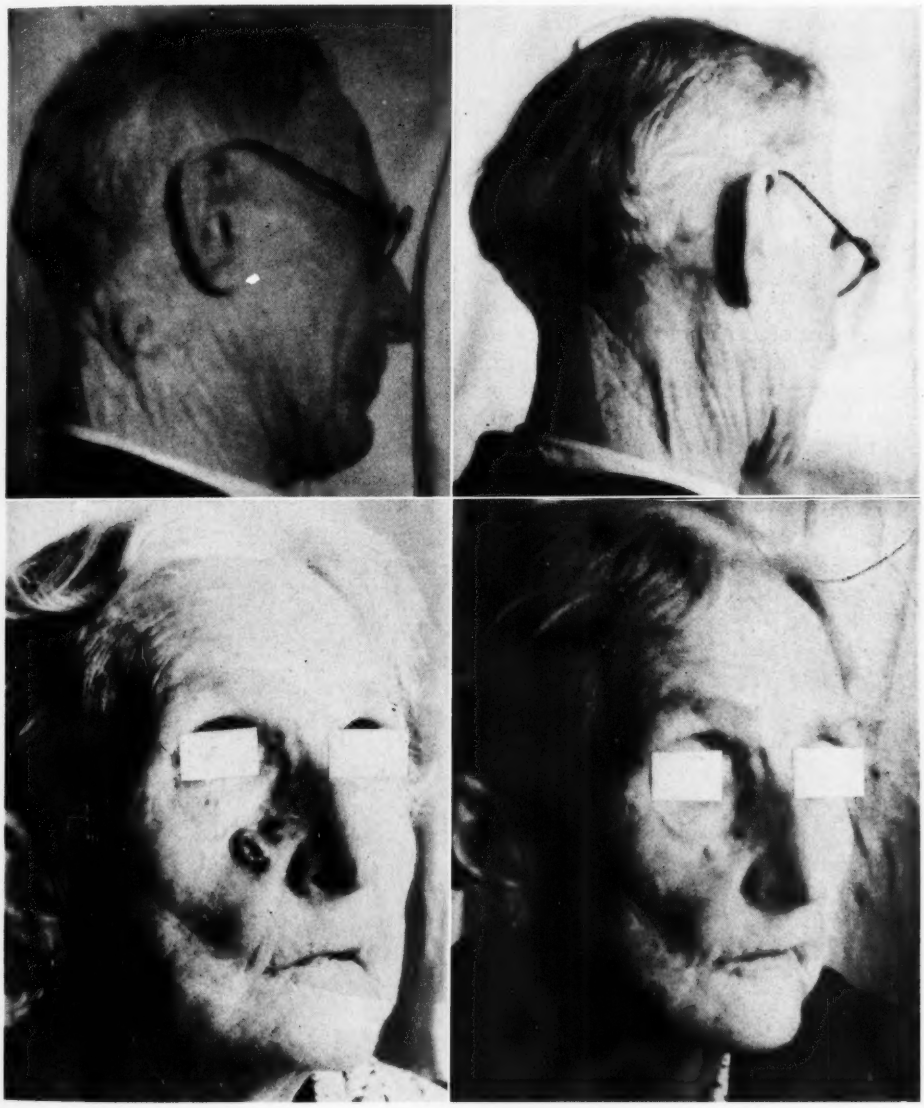

Fig. 5 (*above*). C. P., aged 69, Dec. 21, 1934, squamous carcinoma 3 cm. wide, raised surface. Four months' duration. Treatment, 6,000 r units, unfiltered, within a week. Healed with perfect cosmetic result by Feb. 21, 1935. No return or metastases to date.

Fig. 6 (*below*). Mrs. N., aged 86, July 16, 1936, basal-cell epithelioma (began as pimple seven months before), 1.5 cm. wide. Treatment, 6,000 r units, unfiltered, within 12 days. Healed with perfect cosmetic result, Aug. 27, 1936. No return to date.

cers seldom metastasize, but if they are of long standing, may develop to such an extent as to become incurable.

Squamous-cell carcinoma is differentiated from the basal-cell carcinoma in that it forms prickle cells and epithelial cells with protoplasmic processes between them. There is a mixed cell type which has some basal and some squamous cells, which occurs in a small percentage of the cases.

One method of grading malignancy of the skin cancer is based on the number of malignant cells or the amount of tumor cells as they approach the normal. As a rule, the more embryonic or lower cells present in the tumor or specimen, the quicker the response to radiation. The higher grade the cells, the more radioresistant. The clinical symptoms, age of the tumor, and the amount of infiltration should govern the amount of treatment and decide the probable response to radiation.

All pre-cancerous lesions, such as moles, warts, crusts, and fissures, should be eradicated. Such lesions can be removed by electrocoagulation followed by irradiation. They can, however, be removed by x-ray therapy alone, if sufficient dosage is given.

Almost since the discovery of roentgen rays skin cancer has been treated successfully by this method. Much controversy has arisen at times between the value of the x-ray and radium for treatment of these tumors; however, there seems to me to be no real reason for this controversy, for skin cancer can be treated successfully by either x-rays or radium. The biological action of the x-ray is for all practical purposes the same as that of radium. Treatment can be given with x-ray in less time and with less expense involved, and a beautiful cosmetic effect is the result. Compared with the scalpel, there is much less danger of spreading the malignancy into the blood stream and thereby causing metastasis elsewhere in the body. X-ray is a painless method of treatment. No anesthesia is required. The patient can receive treatment in the office, thus eliminating the item of hospital expense.

Fig. 7.

Fig. 8.

Fig. 7. Miss Y., aged 65, operated on on May 24, 1932, adenocarcinoma of right breast with axillary involvement. Recurrence. Operated on in May, 1933, and April 26, 1934. From July 3, 1934, to June, 1935, four series of x-ray treatments were given—135 kv., 3 mm. aluminum filter. Marked reaction obtained after each series. Patient well in November, 1938.

Fig. 8. Miss M., aged 69, cancer of right breast, no axillary involvement. Operated on in April, 1933, ribs removed. May, 1935, recurrence, three nodes in operative scar. Nodes, 1 × 2 × 3 cm., raised from surface, dark blue in appearance. Treated with unfiltered x-ray, 3,500 r units. Whole area breast treated with filtered x-ray, 135 kv., June 4, 1935, healed. X-ray of chest taken. No metastases. Patient well in November, 1938.

Intensive doses are given to the growth, depending on the size and depth. Between 2,500 and 10,000 r units, or 5 to 20 skin units are used. Treatments are given within a week or ten days. Subsequently, the tumor usually sloughs out within from three to four weeks and is healed with good cosmetic result in from six to eight weeks' time.

I have never used above 110 kv. unfiltered. There seems to be no real reason for higher voltages or deeper penetration as the growths are on the surface, usually not any deeper than from 1 to 1.5 cm.

In regard to skin cancer, it cannot be emphasized too strongly that practically all such lesions can be cured if thoroughly treated in the early stages by intensive doses of x-ray under the present skillful methods available. If skin cancer is treated incompletely with insufficient dosage, picked at, so to speak, or irritated by unskillful methods until it involves the deeper structures, then failure will occur and the greatest skill of the surgeon in combination with x-ray and radium therapy will give the patient only a fighting chance.

Unskillful methods resulting from insufficient training and experience will mean failure and the x-ray as a therapeutic method for treating skin cancer will be held in disrepute.

AN X-RAY STUDY OF THE LUNGS OF WORKMEN IN THE ASBESTOS INDUSTRY, COVERING A PERIOD OF TEN YEARS[1, 2]

By ARIAL W. GEORGE, M.D., *and* RALPH D. LEONARD, M.D., *Boston, Massachusetts*

DUST inhalation is a subject in which we have been particularly interested for the past ten years. Our approach to this problem has been through the medium of the x-ray. During the past five years, the dust hazard in many industries has become a serious economic factor, for the individual workman as well as for the corporation and insurance company. In some instances the amount of alleged disability among the workmen, from dust, had reached such proportions that insurance companies became insolvent, and the industrial plants were forced to close for lack of compensation insurance protection.

During this period, we have had the opportunity of studying the chests of over three thousand workmen exposed to a dust hazard in their regular occupation. This group included various types of dust hazards—mining and manufacturing—and from various parts of this country, east of the Rockies. From this group it has been our privilege to observe with the x-ray the changes in the chest which may result from more or less continuous exposure to various types of dust, such as silica, talc, marble, coal, asbestos, heavy metals, such as iron and brass, and various organic dusts, such as wood fiber.

In this rather cursory paper, it is our purpose to record our observations and conclusions based on an x-ray study of one type of dust hazard, namely, asbestos dust. The disease condition resulting from the inhalation of asbestos dust is that form of pneumoconiosis known as asbestosis. We shall comment on this disease, as an economic problem, as it concerns the insurance companies and the industrial accident boards, and also as a disease condition in the individual, its pathology and prognosis as observed by us through the x-ray.

In 1928, we began the intensive study of those exposed to the asbestos hazard in one of the large industrial plants in Massachusetts, where brake lining was manufactured. The hazard created was principally asbestos, with less than 30 per cent silica. Dry weaving was first used and then changed to wet weaving. This change was brought about by the fact that in 1928 and 1929 there were numerous cases which showed symptoms, referable to the lungs, characterized by increased difficulty in breathing on exertion, cough, sleeplessness, and loss of weight. Of all the cases we examined in 1928 and 1929, our records show that in 12 cases x-ray examination revealed changes in the lungs, upon which we based our diagnosis of asbestosis. These 12 were at once put on compensation or given a lump-sum settlement and have been under observation for seven years, throwing considerable light on the natural progress of the disease. From about 1928 to 1933, we routinely examined those cases suspected clinically of asbestosis. By 1933 the insurance premiums had pyramided to 15 per cent of the payroll, and the carriers were rather indifferent to the taking on of this risk. Finally, one of the large companies decided that before they took over this risk, they would have examined, clinically and by x-ray, all of the employees of the plant, totalling approximately eight hundred. The majority of these workmen were examined by us immediately at the plant. There was a very small number of the total employees whose conditions we diagnosed as asbestosis. Out of this number that we either suspected or diagnosed asbestosis, there were three cases that were definitely advanced. These three cases were of interest because they did not show

[1] Read (in part) by invitation at the Twenty-fourth Annual Meeting of the Radiological Society of North America, at Pittsburgh, Nov. 28–Dec. 2, 1938.

[2] This is one of a series of papers contributed by friends and former pupils of I. Seth Hirsch, M.D.

many of the usual clinical signs; and would not, on account of the high wages they were earning, change their occupations. These three men continued to work until the plant was closed, in 1936. One of the three became a litigant later. The other two disappeared into other industries and are not recorded as claiming disability to date.

A survey of this type naturally revealed many interesting lung conditions aside from asbestosis, such as aneurysm, early healed, active and chronic tuberculosis, heart abnormalities, and many cases of residual changes from previous lung diseases.

The plant was eventually sold to a competitive company and was immediately closed. Within a short time after the closing of the plant, 90 workmen brought in claims for disability due to asbestosis. These 90 cases were examined by us by x-ray and we made a positive diagnosis of asbestosis on 12, with three additional cases questionable. About 13 per cent of the positive x-ray diagnoses, in this group of 90, claimed symptoms of asbestosis. The insurance carrier for this competitive company immediately placed these 12 cased either on compensation or they were given lump-sum settlement in excess of $50,000. The diagnosis was based upon the clinical and the x-ray examinations, principally the x-ray. There were left 78 cases claiming disability, but their physical and x-ray examinations were negative. Of this group of 78 claiming disability, but without physical or x-ray evidence of asbestosis, 30 came to trial. There is, in our city, the Legal Aid Society which furnishes able counsel for the plaintiffs, as well as competent medical experts. A very capable attorney was chosen for these cases, and the late John B. Hawes, Jr., M.D., as the medical expert. He, in turn, examined these cases both clinically and by x-ray. On these 30 cases he made a positive diagnosis. Under our Statutes of Industrial Diseases of the State of Massachusetts is the so-called "Panel Doctors," a group of three, one of whom is a roentgenologist. Under our State Law their diagnosis is final. They had the opportunity to examine 10 of these 30 cases. Their reports in no instance definitely stated asbestosis, but their findings were reported as, "consistent with," or "a slight degree of," or "the probability of" asbestosis. It was obvious in reading their reports that they were not depending on x-ray findings alone, but were giving the benefit of the doubt to the workmen, in many instances being influenced by the history of exposure. The x-ray films of these cases which were diagnosed as positive by the Panel Doctors, we would have called negative. This illustrates the great difficulty in interpreting an x-ray film, as to the presence or absence of lung changes due to asbestosis. In many instances it is a matter of personal opinion, and the value of an opinion is in a large measure in proportion to the roentgenologist's training and experience in this specialized field.

The late John B. Hawes, Jr., M.D., who was one of our distinguished specialists on tuberculosis, always forcefully expressed his opinion regarding an individual who worked in a dust hazard, claiming that exposure for three years or more made the individual a potential case of asbestosis. He so expressed himself when these cases came to trial. We all felt that at least 80 per cent of his positive diagnoses depended upon history of exposure rather than subjective or objective physical signs.

We will not attempt in this paper to take up the question of physical diagnosis, but we will say that it is our firm conviction that at the present time the only method of positive diagnosis is the x-ray, and that aside from the history of exposure there are no clinical pathognomonic signs of the disease. The clinical facts on which Dr. Hawes based his diagnosis and prognosis of asbestosis were as follows: (1) history of exposure; (2) difficulty in breathing on exertion; (3) cough; (4) rapidity of heart action on exertion, and (5) that asbestosis was a progressive disease, once contracted, whether the individual remained in the industry or was removed.

In addition to these clinical observations of Dr. Hawes, it is interesting to note that in our experience a large number of patients showing a definite x-ray evidence of asbestosis, give a history of coughing up blood. The amount of blood varies considerably, usually no more than blood-streaked sputum, occasionally a substantial amount of pure blood. We have speculated considerably as to the etiology of this symptom. It has been observed for some time that workers in asbestos dust are prone to the development of areas of irritation on the hands. In many instances, these lesions develop into open ulcers which are extremely difficult to heal. Microscopic examination of some of these ulcer bases has demonstrated the presence of asbestos fibers embedded in the deep layers of skin. A total removal of the ulcerative tissue containingt he asbestos fibers results in prompt healing of the lesion. It is not impossible that a somewhat similar condition may develop in the trachea or bronchi of the lungs, with a superficial erosion of the mucous membrane, due to the mechanical irritation of the asbestos fiber, and the symptom of hemorrhage, so commonly observed, is due to small bronchial ulcers.

It has also been observed that asbestos dust like silica and some of the other dusts seems to have a selective action. In other words, certain individuals seem sensitive to the asbestos dust and others are immune. It is a very common experience to find two individuals working in the same concentration of dust for the same length of time and same type of work, and only one developing asbestosis; the other remains in perfect health. No satisfactory explanation has been made of this apparent idiosyncrasy. It is possible that the explanation may be a simple one, namely, the method of breathing. The man who habitually breathes through his nose, with all the protective mechanism which Nature has furnished to prevent dust hazard, would have much less chance of developing injury to his lungs than the man who habitually breathes through his mouth and does not receive the benefit of the protective organs of the nose and nasal pharynx.

As a side-light on the question whether or not asbestosis is a progressive disease, I

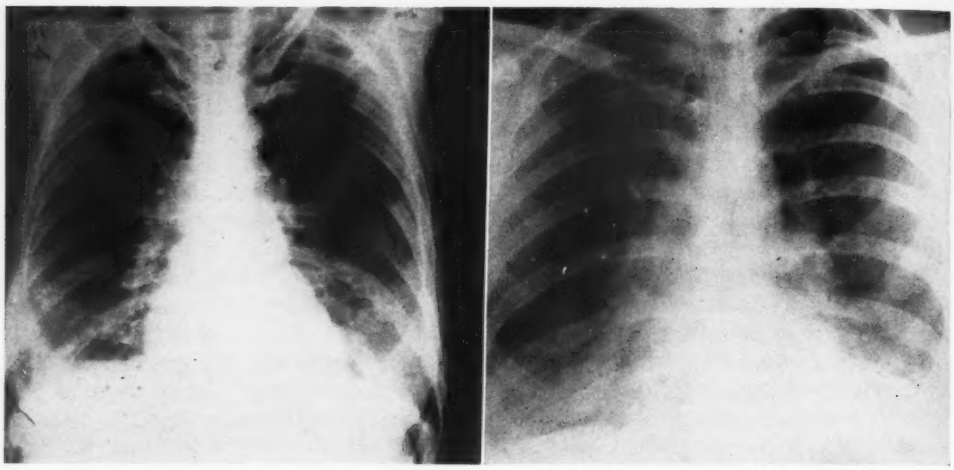

Fig. 1. Fig. 2.

Fig. 1. Case 1. Mrs. A., examined impartially in 1931, was negative; 1936, positive. Intermittent employment from 1919 to 1929, from 1931 to 1934.
Fig. 2. Case 2. Mr. D., more than six years' continuous exposure.

would now like to refer to the 12 cases previously mentioned, that were diagnosed as positive in 1928 and 1929, given compensation, and discharged. At one of the hearings they were re-called by the insurance company to illustrate that these 12 who had been found positive by both clinical and x-ray examination were, by their own testimony, free of all symptoms, and, except for several women in the group, were doing laborious work in their new occupations. If, according to Dr. Hawes, asbestosis is a progressive disease, once contracted, these individuals should have been in the same condition as in 1928 and 1929, or much worse. It would be logical to assume that eight or nine years away from the industry, without symptoms, gives us very definite evidence that this disease, provided we were correct originally, is not a progressive one, at least in this particular industry.

Fig. 3.

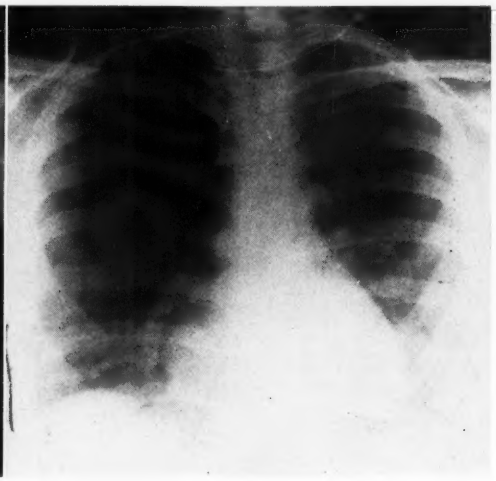

Fig. 4.

Fig. 3. Case 3. Mr. K., more than six years' intermittent exposure.
Fig. 4. Case 4. Mr. Y., more than six years' exposure.

It is evident that if a history of exposure to asbestos dust is eliminated, a positive clinical diagnosis of asbestosis cannot be made. In other words, there is no one physical finding or group of objective signs which are pathognomonic of asbestosis. We are of the opinion that in x-ray examination we have the best and perhaps the only method of diagnosis of asbestosis at the present time.

The x-ray reveals the actual tissue changes in the lungs. In a general way these changes are much less extensive, as compared with silicosis or anthracosis. We find little parallel between the extent of the visible pathology and the severity of the clinical symptoms. It has been impracticable to classify the disease into different stages. All of our positive cases have shown about the same amount of lung involvement.

The theoretical "early" or "incipient" asbestosis, a stage before visible lung changes are present, cannot, of course, be diagnosed by the x-ray. On the other hand, we are of the opinion from our general observations, and it is the opinion of several clinicians who have studied these cases, that asbestos dust will not give symptoms until there has been sufficient lung-tissue change to be visible on an x-ray film. The average uncomplicated case of asbestosis gives rather consistent and characteristic x-ray findings.

In the first place, there is an increased density in the lung-fields. This increased

density is characterized first by bilateral distribution, and, secondly, by its being limited to the lower lobes of both lungs. The quality of the shadow is characterized by a homogeneous quality and is described

Fig. 5. Case 5. Mr. H., more than six years' exposure.

in the literature as a "ground-glass" or "smoky" appearance. The microscopic changes in the lung show that we are dealing with an almost interstitial fibrosis with areas of atelectasis of the alveoli and smaller bronchioles. There is an absence of the gross nodulation seen in silicosis. What nodulation there is has a fine, evenly distributed quality. There are no characteristic changes about the root shadows. Some cases are associated with hilum fibrosis and glandular enlargement, but many cases of asbestosis show no variation in the appearance of the hilum shadows. Often there is some accentuation of the bronchial shadows. There is frequently found a peculiar appearance of the bronchial tree in both lower lobes, in that it presents a rather laminated appearance. This peculiar arrangement of the bronchial shadows is apparently due to localized areas of emphysema scattered throughout the lower lobes. The microscope tells us that the basic pathologic change is the deposit of a protective element about the asbestos fiber, rather than a destructive process of the lung tissue. The asbestos fibers appear to be surrounded by a substance uniform in character and having the appearance of connective tissues. It would appear from a study of the slides that the fiber is innocent of producing any pathologic disturbance, except an impedance to the air in this region of the lung. In other words, in asbestosis we are dealing primarily with an atelectasis due to the mechanical blocking of the alveoli and bronchioles by the protecting fibers about the asbestos fiber. This peculiar diffuse microscopic fibrosis, associated with atelectasis and microscopic areas of emphysema, is the type of change that produces the so-called "ground-glass" appearance on the x-ray film.

In the second place, asbestos dust produces changes in the pleura, the most constant finding being an accentuation of one or more interlobar pleural septa. The microscope shows that fibrosis associated with the asbestos fibers is prone to involve the pleural covering of the lung. The demonstration of pleuritic adhesions of both lower chests, with obliteration of the costo-phrenic angles, is a rather constant finding in uncomplicated asbestosis.

In the third place, the x-ray shows the usual signs of emphysema. This emphysema, of course, is not pathognomonic of asbestosis but when accompanied by other x-ray indications, can be considered of a confirmatory nature. This evidence of emphysema is best demonstrated by the limited excursion of both diaphragms and the increased radiability of the lung tissue.

In the fourth place, we have noted in the cases of asbestosis certain changes in the contour of the heart shadow which we feel is somewhat causally related to the process in the lungs. Other writers have put considerable emphasis on the dilatation of the right auricle and ventricle, as evidence of asbestosis. It is our opinion that dilatation of the right side of the heart is seen in a higher percentage of asbestosis cases than in other forms of pneumoconio-

sis, particularly silicosis. There is a theoretical possibility that the type of interstitial fibrosis seen with the asbestos dust is such as to produce a mechanical interference with the circulation in the perialveolar capillaries and that this embarrassment in the pulmonary circulation results in some hypertrophy or dilatation of the right side of the heart. We have not observed any demonstrable dilatation of the pulmonary artery.

There are several points which are of importance in the differential diagnosis between asbestosis and other forms of pneumoconiosis, and also between asbestosis and other shadows, due either to faulty technic or to variation in the lung markings from other conditions not connected with the dust hazard. It would seem unnecessary to mention faulty photographic technic. It is our belief that many erroneous x-ray diagnoses of asbestosis have been made on x-ray films which were either under-exposed or over-exposed. The physical qualities of the individual should also be taken into consideration. A woman with large breasts will give an x-ray picture which may have all the characteristics of lung changes due to asbestosis. The fact being, however, this variation in density is due to chest-wall structure, rather than to changes within the chest cavity.

There are certain points of importance in the differential diagnosis of asbestosis and silicosis.

(1) The increased density in asbestosis is confined to the bases; in silicosis it is primarily found in the central portion of both lungs and frequently the bases are clear.

(2) The nodulation of asbestosis is the fine granular-type areas; in silicosis the nodulations are coarse and in the advanced stages they become conglomerate, producing areas of apparent consolidation.

(3) The pleura is more likely to be involved in asbestosis than in silicosis. The same is true of the hypertrophy of the right side of the heart in asbestosis. In our experience this heart condition is rarely seen in silicosis. In this particular industry which we have studied, the percentage of silica, where it was found in the dust tests, was less than 30 per cent, and we have not been bothered by a combination of asbestosis and silicosis. It is conceivable

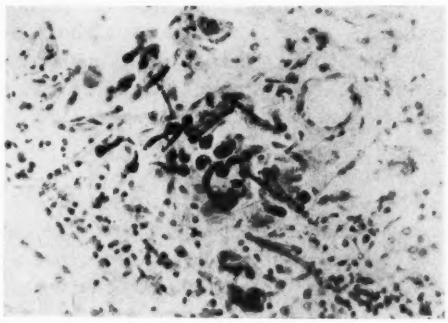

Fig. 6. Photomicrograph of section of lung showing asbestos bodies. (Courtesy of Liberty Mutual Insurance Company.)

in certain industries, and perhaps in the mining of asbestos, we may have a dust hazard of asbestosis with a high percentage of silica. In the advanced cases of pneumoconiosis due to this double hazard, it might be fairly easy to determine from the x-ray the amount of disease due to the silica and that due to the asbestos fiber, but in the average case an accurate interpretation of pneumoconiosis due to both asbestos and silica would be a difficult procedure.

In this series of cases we have found no case of complicating tuberculosis. From our experience we are of the opinion that asbestosis is not prone to the development of tuberculosis, and we have had no case in which there was evidence of asbestosis lighting up a pre-existing tuberculosis. The differential diagnosis between asbestosis and tuberculosis is reasonably easy. The diseases have little in common, as far as their x-ray appearance is concerned. This is not true in cases of silicosis complicated by tuberculosis. It is sometimes difficult to make a differential diagnosis between asbestosis and certain conditions which produce congestion of the lower lobes of the lungs or accentuation of the

bronchial shadows in the lower lobes. Chronic passive congestion associated with heart lesion might well simulate conditions of asbestosis. The differential diagnosis in such an instance depends considerably upon the clinical history. Chronic bronchitis or bronchiectasis might produce a picture somewhat confusing with asbestosis, but neither of these conditions usually shows the characteristic "ground-glass" increased density over the lower lobes.

CONCLUSIONS

(1) It is our opinion that every industry with an asbestosis hazard must be a special study in itself. All asbestos mining and manufacturing cannot be classified in one group as to the dust hazard. The percentage of silica in the asbestos dust must be taken into consideration. The method of manufacturing, whether it is the dry or wet method, is of importance.

(2) We are of the opinion that the disease, asbestosis, is not a progressive disease after the individual has been removed from the dust hazard.

(3) There is no evidence in our study of asbestosis for the past ten years that asbestosis has any causal relation to tuberculosis.

(4) It is our opinion that the final diagnosis of asbestosis must depend mainly on the x-ray evidence, that there are no clinical findings pathognomonic of asbestosis, and that an amount of asbestos dust in the lungs, sufficient to produce symptoms, will give visible evidence of tissue changes on the x-ray film.

ULCER NICHES WITH STOPPER-SHAPED VASCULAR DEFECT[1]

By ÅKE ÅKERLUND, M.D., Director of the X-ray Department of the Maria Hospital, *Stockholm, Sweden*

FOR the past 12 years I have been collecting a small series of ulcer cases with roentgenological niche formation, all presenting a special characteristic and interesting morphological feature which, so far, I have not seen depicted in the roentgen literature. The only reference to this feature which I have seen in the literature is a short—just a few lines—unillustrated contribution to a discussion by H. H. Berg at the German Roentgenological Congress, in Dresden, in April, 1932, after a paper read by H. U. Albrecht on "Roentgen Anatomical Findings in the Digestive Canal in Reference to their Patho-anatomical Substrata."

Fig. 1.

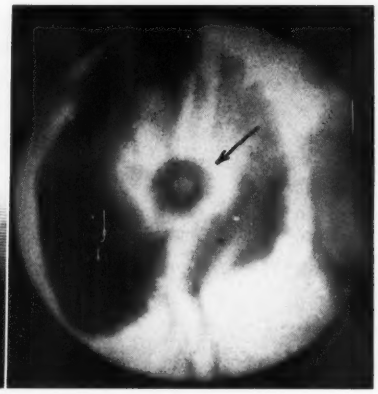

Fig. 2.

Fig. 1. Juxtapyloric gastric ulcer; niche with vascular defect.
Fig. 2. Duodenal ulcer; bulbar niche with central vascular defect.

In the first place, I would like to give an account of my own limited material. It is made up of but six ulcer cases, all with niches: one case of juxtapyloric ulcer of the stomach; three cases of ulcer of the duodenal bulb; a fifth case of ulcer of the descending part of the duodenum, and a sixth case of a peptic jejunal ulcer after resection of the stomach. One of the cases was placed at my disposal by the courtesy of Professor H. H. Berg of Hamburg, and another case was radiographed by Dr. W. Magnusson at Sophiahemmet, in Stockholm, shortly before I was consulted by the surgeon in attendance, operation being considered, as to the interpretation of details in the radiogram.

The interesting feature in the roentgen findings is identical in all the six cases and of typical appearance. In *en face* films, with suitable compression, there is seen *within the niche shadow a circular defect more or less centrally situated and sharply defined* of a thickness of about a knitting-needle or a match. In successful profile films I have sometimes been able to show that the defect is somewhat elongated and *stopper-shaped and that it extends from the bottom of the niche.*

A brief account of the six cases will follow.

[1] This is one of a series of papers contributed by friends and former pupils of I. Seth Hirsch, M.D.

Fig. 3. Duodenal ulcer; bulbar niche with central vascular defect.

having further abdominal symptoms with severe vomiting. Weber's reaction in feces strongly positive (Fig. 1). Diagnosis, juxtapyloric gastric ulcer with niche formation on the minor curvature; rounded vascular defect in the niche.

Case 2. (Professor H. H. Berg's case, Figure 2.) Recent ulcer of the duodenal bulb without any other deformity than an *en face* niche surrounded by a circular clearer zone. On a compression film, a vascular defect can be clearly seen within the niche.

Case 3. A married woman, 35 years of age, has had recent recurrent duodenal ulcer. Two years ago she suffered a period of epigastralgia, and has been having hunger pains and nightly pains for three or four weeks. There is no melena. An *en face* niche appears in the bulb on compression surrounded by a circular clearer zone; in the niche there is a rounded central vascular defect (Fig. 3).

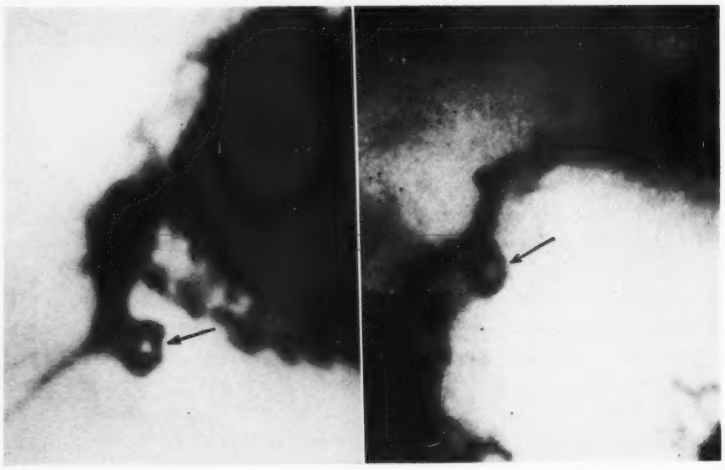

Fig. 4. Fig. 5.

Fig. 4. Chronic duodenal ulcer; bulbar niche with vascular defect.

Fig. 5. Chronic ulcer in the descending part of the duodenum; distal niche with vascular defect.

Case 1. Male, aged 66 years. Periodical ulcer symptoms for the past twenty years or so; three or four years ago, tarry stools. For the last few days he had been

Case 4. When operation was being considered, this case was referred to me for consultation by Professor Einar Key. Chronic duodenal ulcer with marked shrink-

ing of the bulb is shown in Figure 4. On its lower side, and just beyond the pylorus, there is a niche the size of a pea, in the center of which there is a well-marked rounded vascular defect.

Case 5. Male, aged 53 years, had had six months ago, and lasting for six weeks, copious hematemesis, the latest hemorrhage occurring in conjunction with persistent severe epigastralgia. A week after ulcer treatment, which was immediately instituted, Weber's reaction was negative in the stools. A distal duodenal ulcer was visible on the concave side of the upper portion of the descending part of the duodenum (Fig. 5). In the niche formation, the size of a coffee bean, there is a constant and distinct vascular defect.

Case 6. Male, aged 35 years, had been having recurrent symptoms of duodenal ulcer for the past 20 years. Three years ago he was operated upon for duodenal ulcer (resection of stomach according to Billroth II). For the past three weeks he has been having nightly epigastric pains. There was emaciation, increasing pallor, and positive Weber's reaction. There was a peptic jejunal ulcer close to the site of the gastro-enterostomy (Fig. 6). In the niche there is a rounded central arterial defect.

For years I have deferred the publication of the report of these cases in the vague hope of getting an opportunity of autopsic confirmation in at least one of them, but, so far, I have in no single case had access to the anatomical specimen in relation to the roentgen examination. It should perhaps also be pointed out that in those cases in which I subsequently, after one or several months or years, had the opportunity of checking the examination, the defect was not found to persist even in those instances in which a niche formation could be demonstrated at about the same place.

Although there is thus no autopsic confirmation of my cases, there would scarcely seem any doubt about the anatomical basis of these roentgen findings. There can be no question of any gas bubble, blood clot, or remaining food residue; as evidence against any of these possibilities, we have the constant central position of the defect in repeated serial films and in different positions of the body, as well as its shape, size, and general appearance in *en face* and profile films. Nor have analyses of pathoanatomical preparations revealed any central stopper-shaped projections of granulations.

Fig. 6. Peptic jejunal ulcer; niche with vascular defect.

The only explanation left, then, is that the defect is caused by a vascular plug projecting from the floor of the ulcer and in his aforementioned statement Berg also briefly related a case of gastric ulcer in which an arterial stump, the size of a grain of rice and protruding from the floor of the ulcer, was considered the likely anatomical basis of the roentgen finding in question.

Most of us probably recall from the illustrations of our pathological textbooks and from pathological specimens the typical appearance of a gastric or duodenal ulcer, into the floor of which we found a rigid and thickened, perhaps aneurysmatic arterial stump, protruding like a stopper into the lumen of the ulcer crater, either thrombosed or eroded (Figs. 7, 8, 9). A film of that nature from Kaufmann's "Special

Pathological Anatomy" and from Hurst and Stewart's monography "Gastric and Duodenal Ulcer," as also a diagram showing the typical roentgen finding in an *en face* and profile film, are shown in Figure 10.

Fig. 7.

Fig. 8.

Fig. 7. From "Special Pathological Anatomy," Kaufmann.
Fig. 8. From "Gastric and Duodenal Ulcer," Hurst and Stewart.

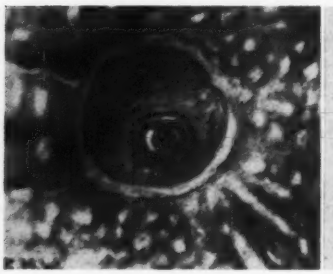

Fig. 9.

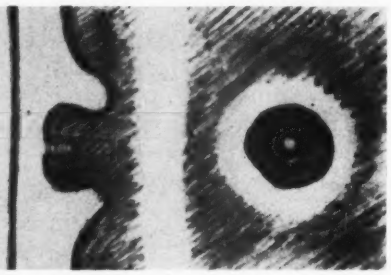

Fig. 10.

Fig. 9. From "Gastric and Duodenal Ulcer," Hurst and Stewart.
Fig. 10. Diagram showing the roentgen finding: niche with central vascular defect in an *en face* and profile drawing.

Obviously, a roentgen finding of this type must influence our therapeutic handling of the case and urge us to exercise great care in dealing with it. On the other hand, it should be pointed out that but one of the six cases reported herein had had large and repeated hemorrhages, and these had been, fortunately, without fatal issue.

This roentgen finding shows to what point of accuracy and fineness we are able, in favorable cases, to stretch modern roentgenological ulcer diagnosis. In many cases, the result of a roentgenological examination to-day affords us scarcely less information than a scrutinizing examination, by the naked eye, of a patho-anatomical specimen, so far as the abundance of details is concerned.

SUMMARY

Six cases of ulcer with niche formation in the stomach, duodenal bulb, descending duodenum, or jejunum, respectively,

characterized everywhere by a stationary, stopper-shaped, rounded defect in the center of the niche, of the thickness of a knitting-needle or a match, are demonstrated. Although no autopsic verification was available in any of the cases, the author considers himself justified in assuming that the abnormal formation is due to a thickened arterial stump which, in a stopper-shaped manner, projects into the niche from the floor of the ulcer.

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THE BIOLOGY OF BONE METASTASES[1]

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IT has been definitely established, since Samson, in 1834, described the first case of bone metastasis, that one of the common sites of metastatic deposits of malignant tumors is the skeleton. The bones, liver, and lungs are the most frequent sites of hematogenous metastases, not taking into account the involvement of the regional lymphatic glands through the lymphatic spread.

Skeletal metastases may arise from malignancy of any organ. However, it is a biologic fact that newgrowths of different organs vary in the frequency with which they metastasize to the skeleton. Kitain, from the Lubarsch Institute, in Berlin, found bone metastases in 10 per cent of all cases of carcinoma. On this basis, two types of carcinomas may be distinguished. The first includes carcinomas of those organs in which bone metastases are more frequent, or, at least, as frequent as the average site. The second group consists of carcinomas of those organs in which bone metastases are less frequent than above mentioned. The carcinomas of the first group may be called *ossophile*, and those of the second group *ossophobe*.

In the *ossophile* group are the carcinomas of the prostate, thyroid, breasts, and kidneys. Obviously, we are dealing with organs which have a glandular structure and a cylindrical epithelium.

The *ossophobe* group, also, shows a definite anatomic structure. Squamous-cell epithelium carcinomas, those originating in the skin, mouth, esophagus, and portio uteri, very rarely (only in 1 per cent) produce bone metastases. It is obvious that the histologic structure of the organs in which the primary tumors originate has a definite influence on the frequency of bone metastases.

However, this cannot be the only decisive factor, for there is a large group of carcinomas of the gastro-intestinal tract which do not produce bone metastases more often than do the squamous-cell epithelium carcinomas, in spite of their origin from the cylindrical epithelium.

The biological influencing factor may be that the ossophile carcinomas are usually small. Because of the small size of the primary tumors, it is not unusual to find bone metastases before the primary tumors are detectable. These tumors are so small that they may not be found clinically or roentgenologically. Occasionally, even at autopsy, in spite of the presence of an epithelial bone tumor, which definitely is metastatic, the primary tumor cannot be found.

Most carcinomas of the gastro-intestinal tract, are, however, of considerable size, so that we are often able to feel them and demonstrate them roentgenologically, even though they are deep-seated.

Taking those two facts into consideration, we reach a conclusion which was first proved by Ehrlich. He found in his experiments with mouse carcinomas, that "the percentage of metastases in slow-growing, spontaneous tumors is comparatively much higher than in slow-growing implanted tumors." Ehrlich called this phenomenon "arthreptic immunity."

Summing up, we can say that the ossophile tumors are characterized on the one hand, by the histologic structure of the organ of their origin, and, on the other hand, by a small size at their site of origin. The character of original tissue may be called the constitutional factor, and the size of the tumor, the conditional factor, having a bearing on the origin of a bone metastasis.

[1] This is one of a series of papers contributed by friends and former pupils of I. Seth Hirsch, M.D.

The fact that the skeleton is so often the site of metastases of certain carcinomas is still more remarkable when we consider that the skeleton, lacking an epithelium, can never be the origin of a primary carcinoma. This fact is still more striking, because primary bone tumors, such as sarcomas of the bones, only rarely produce bone metastasis. Those tumors, rather, metastasize into different organs, especially the lungs.

This antagonistic behavior gives us the impression that the ossophile carcinomas are apparently debilitated or not aggressive, so that large tumors are not produced at their site of origin. As these carcinomas are disseminated by the blood stream, they are able to develop only in the skeleton because the bone tissue does not possess an epithelium, and, therefore, is not able to produce a defense mechanism against the foreign epithelial new-growths.

In corroboration of this theory, stands the fact that after metastasizing in the skeleton, other organs, striking as it may seem, may remain a comparatively long time free from metastases. Von Recklinghausen was the first to point out this fact in a case of carcinoma of the prostate in which a general spread of the carcinoma was found in the bony system, but not in the soft tissues. This fact has been emphasized repeatedly in carcinomas of different origin. The frequency of bone metastases as compared to simultaneous visceral metastases varies with different types of carcinomas. It is, however, a fact that patients with lung metastases only occasionally show bone metastases and, *vice versa*, patients after having widespread metastases in the skeleton, are free from lung metastases for a long time, even as long as they live.

The general fact that only slow-growing carcinomas of certain histologic structure metastasize to bone without affecting the viscera, may be called the first fundamental principle of the biology of bone metastases.

The second fundamental principle is that different parts of the skeleton differ in frequency as to the site of metastases, the most frequently affected being the spine, particularly the lumbar vertebræ, the dorsal vertebræ, the pelvis, and the adjacent parts of the femur are next in frequency. All the other parts of the skeleton are not so frequently affected; this is especially true of the extremities. The behavior of bone metastases differs in this from the behavior of the primary bone sarcoma, which is most often found in the extremities, whereas it but seldom develops in the spine or the pelvis.

The fact that the lumbar vertebræ and the pelvis are most frequently involved by metastases, suggested to Von Recklinghausen that the metastases are implanted in such parts of the skeleton as are exposed to the greatest pressure. Were this a decisive factor, metastases would not be found only in the lumbar vertebræ and in the pelvis, but as frequently in the bones of the lower extremities and especially in those of the legs and feet, for there is probably no part of the body which is more subjected to the effects of weight-bearing than the feet. As already mentioned, it is an exceedingly interesting fact that the lower extremities, from the knees down, are practically free from metastases, and these are but rarely found in the upper extremities distal to the elbow joint. Below the knee and elbow joints, metastases are extremely uncommon. Consequently, it is not the greater static, but rather the less dynamic usage which predisposes to the development of bone metastases. In parts of the skeleton which are less used dynamically as, for instance, the spine, there are apparently better conditions for retention of the carcinoma cells which are brought to it through the blood stream. In the less used parts of the skeleton the blood stream is slower, and permits easier retention in the bone marrow to which the tumor cells are carried by the blood stream.

Of further biologic interest is the fact that bone metastases develop infrequently in the cortex, but more often in the spongiosa, so that most of the bone metastases begin as bone marrow metastasis.

The tumor tissue which intrudes into the bone usually causes dissolution and progressive disappearance of the portion involved. We, therefore, speak of an osteolytic (osteoclastic) effect of the bone metastases. It is known since Von Recklinghausen's first description that in the neighborhood of a bone metastasis a formation of new bone tissue is occasionally seen which is called osteosclerotic (osteoplastic) bone metastases.

The fact that the dynamically less used parts of the skeleton, such as the spinal column, are much more frequently the site of metastases than the extremities, is also demonstrated by the varying frequency of the osteoplastic and osteolytic metastases.

Osteoplastic metastases are more common than the osteolytic in parts of the skeleton which are less used and are still less common than the osteolytic metastases in bones which are more dynamically used. Therefore, as frequently as osteoplastic metastases are found in the spinal column or the pelvis, so rarely can they be demonstrated in the extremities or the skull. The difference is such that in the same case different types of metastases are found in different parts of the skeleton. For instance, in carcinoma of the prostate gland, while the pelvis and the spinal column contain osteoplastic metastases, the skull or the humerus may be destroyed by osteolytic foci.

We were able to show that the osteoplastic character of a metastasis is influenced, first, by the *site of the primary tumor;* second, by the *site of the metastasis.* A further factor may be the *scirrhous character of the primary tumor,* as often seen in carcinoma of the breast. This fact is easy to understand, as the formation of bone does not originate from the tumor cells but from the stroma of the carcinoma, and as the latter invades the endosteum, for the scirrhous character of a tumor shows the constitutional ability of the individual to form considerable carcinomatous stroma. These are fundamental for the development of an osteoplastic metastases. A further etiologic factor is the traumatic separation of the continuity of the bone. Spontaneous fractures are not infrequently found in cases of metastases in the extremities. It is a well-known fact that pathologic fractures in cases of metastases have a definite tendency toward spontaneous healing. These fusions often appear clinically, as a spontaneous healing of the carinoma. As a rule, the roentgenogram shows the continued existence of carcinomatous destruction. Erdheim has proved this fact histologically. Therefore, the frequent consolidation of a spontaneous fracture in a case with metastases in the skeleton is not a healing of the carcinoma, but only an osteoplastic carcinoma reaction caused by the trauma. The carcinoma cells do not disintegrate but there is bone formation originating from the connective tissue of the carcinomatous stroma which adapts itself to those changes produced by the trauma and consequently has the appearance of callus. Definite osteoplastic reaction in bone metastases is seen after x-ray treatment. This reaction is especially marked in instances in which there is an original tendency to osteoplasia, particularly in tumors of the scirrhous type. A considerable new formation of bone, after roentgen treatment of purely osteolytic metastases, may occur in cases of carcinomas especially sensitive to the rays, as, for instance, in carcinoma simplex. Metastases of such type may be entirely destroyed so that the consequent osteoplastic reaction means a *restitution ad integrum.*

The fact that some tumors more frequently produce osteolytic and others, more frequently osteoplastic metastasis, has a practical significance in roentgen diagnosis. On this basis, we are able to differentiate certain roentgenologic types of bone metastases. Thus, it is possible to distinguish:

(*A*) Metastases of a purely osteolytic type (*tabula rasa,* Kienböck; *spotty type,* Hintze). These are most frequently found in carcinoma of the kidneys. The bone

substance looks as if dissolved by chemical agents, producing widespread defects which have no definite form, the whole cross-section of the bone being destroyed and the bone substance having definitely disappeared.

(*B*) Metastases of the osteolytic type, with shell formation (*cystic type*, Kienböck; *soap bubble*, Schintz). This type most frequently results from carcinoma of the thyroid gland. In these cases, only the inner part of the bone is dissolved, as in metastases from kidney carcinoma, while the cortical border of the bone remains intact for some time, so that there is a shell formation around the tumor. However, bone trabeculæ may sometimes still be present inside of the bone, thus producing a honeycomb appearance. There is still another type of osteolytic metastases, in which only the border of the bone disappears while the remainder of the bone continues intact. This erosive form is found in different bone tumors and has, therefore, no differential diagnostic significance.

(*C*) Metastases of a purely osteoplastic type (ivory or marble bones). These are most frequently found in carcinomas of the prostate. In these cases, the bone marrow becomes filled with new bone so that the total density of the bone is increased without any change in the shape and contour of the involved bone.

(*D*) Metastases of the osteoplastic type with islands of increased density. They are most frequently seen in carcinomas of the breast. Only parts of the bone become sclerotic. Those sclerotic parts in the spongiosa resemble islands of compacta. The form of the diseased bone remains unchanged.

(*E*) Metastases of the mixed type (the tiger-skin type). This type also most frequently results from carcinoma of the breast. The mixed type is found in two different forms. In the one form, there are areas in the center which are osteolytic, while the peripheral parts are dense. In the other form, different parts of the skeleton, for instance, the vertebræ, are osteolytic, while the neighboring parts are osteoplastic. In the osteolytic parts of the bone, the outward form is very definitely changed, whereas in the osteoplastic parts the form is still preserved.

The metastases of the four organs (breast, prostate, kidneys, and thyroid) show certain differences. The bone metastases in breast and prostate carcinoma constitute one group. The bone metastases in kidneys and thyroid carcinoma constitute the other group.

The bone metastases of the first group are usually (prostatic) or very often (mammary) of the osteoplastic type, while this is extremely rare in the second group, which is nearly always osteolytic.

The skeletal metastases in breast and prostate carcinoma most frequently involve the spinal column and pelvis. In kidney and thyroid carcinoma, however, the extremities are relatively frequent sites of the metastases.

The bone metastases of the first group are usually multiple, and not rarely generalized. Very frequently, however, the kidney and thyroid metastases in the skeleton are solitary.

In breast and prostate carcinoma, the finding of bone and lung metastases at the same time s much less common than in kidney and thyroid carcinoma, or, if bone metastases are present, lung metastases develop much later in the first group than in the second.

The bone metastases of the rest of the carcinomas have no special features. As they are quite uncommon, we do not know much regarding their roentgenologic behavior, but they are apparently on the whole of the osteolytic type. This process may lead to a complete absorption of bone or to destruction of the contour, even to expansion of the bone. Osteoplastic bone metastases apparently develop seldom.

The above-mentioned facts regarding the biology of the bone metastases have points of practical significance. These are:

(1) Qualitative: osteolysis or osteosclerosis.

(2) Quantitative: extension of the diseased part.

(3) Topical: site of the metastasis, part of the skeleton and part of the bone, as well as behavior of other organs.

(4) Numerical: solitary, multiple, generalized.

SUMMARY

1. Carcinomas of certain histologic structure, such as squamous-cell epitheliomas, produce only few bone metastases and therefore should be called *ossophobe*. Cylindrical epitheliomas, on the contrary, produce bone metastases more frequently and therefore should be called *ossophile*.

2. Beside the histologic structure, the rapidity of growth and the site of the primary tumor are the determining factors for the frequency of bone metastases. Slow-growing, therefore small, tumors produce extensive bone metastases much more frequently than rapidly growing tumors.

3. Different parts of the skeleton differ in frequency as to the site of metastases, and the less dynamically used a portion of the skeleton is, the more often it is the site of the metastasis. Therefore, the lumbar vertebræ and the pelvis show bone metastases most frequently, whereas the forearms and legs are rarely sites of metastases.

4. Whether the bone metastases are osteolytic or osteoplastic is determined by the site of the primary tumor, the site of the metastases, the connective tissue content of the primary tumor, as well as a contributing trauma.

5. Taking these facts into consideration, we are able to determine, to a certain degree, the site of the primary tumor. Especially metastases from carcinomas of the thyroid, prostate gland, kidneys, and breast very often show characteristic signs which may be determined roentgenologically.

FURTHER NOTES CONCERNING TRAUMATIC SUBDURAL HEMATOMA[1]

By SIDNEY W. GROSS, M.D., *New York City*

THE relation of trauma to subdural hematoma was not clearly indicated until the contribution of Trotter (1) in 1914. The cerebral veins entering the lacunæ of the longitudinal sinuses are extremely thin-walled, unsupported, short, and without tortuosity. The ends of these unsupported portions of the veins are fixed to the rigid dural sinus, while the other ends are attached to the movable cerebral hemisphere. An injury to the head resulting from the application of a force to the frontal or occipital region produces a movement of the brain without any marked alteration in the position of the dura. This may result in a tear in a cerebral vein, usually at its rigid attachment to the longitudinal sinus.

This portion of the vein is extra-arachnoid, so that bleeding occurs into the space between the arachnoid and the dura—the subdural space. Absorption does not take place in the subdural space, so that the clot becomes rapidly encysted. The surface of the clot nearest the dura becomes covered by a layer of fibroblasts and connective tissue, forming a membrane from 1 to 5 mm. in thickness. The surface of the clot adjacent to the arachnoid becomes covered by a layer of arachnoidal cells of transparent thinness. The cyst then increases in size by osmosis, as described by Gardner (2), and probably also as the result of new bleeding from the many capillaries in the outer neo-membrane.

The following abstracts will illustrate the variations in the signs and symptoms which were found in a group of 12 cases.

Case 1. Colored female, 48 years of age, admitted to the hospital Feb. 5, 1935. On admission she was stuporous and a history was not available. Both eyes were deviated to the right, there was a right hemiparesis with a positive right Babinski. The left pupil was larger than the right, and both reacted poorly to light. The nasal margins of both optic discs were blurred. Pulse rate was 60, and blood pressure 160/100. X-ray examination of the skull was negative. Twelve hours after admission the stupor had increased to deep coma. Spinal puncture yielded a clear colorless fluid under slightly increased pressure, and which showed ten lymphocytes per centimeter and a slight increase in globulin. Bilateral trephine exploration in the fronto-temporal regions was done. A large subdural hematoma containing yellowish syrupy fluid was found. Following its evacuation the patient made an uneventful recovery. After her operation the patient gave a history of having received a fist blow to the head five weeks previously.

Case 2. White male, waiter, aged 25 years, was admitted on Dec. 20, 1934, because of occipital headaches, vomiting, and failing vision. One month previously he had received a blow to the jaw and was "knocked out" for a few minutes. However, he continued at work for 12 days, when severe occipital headaches forced him to stop.

Examination revealed bilateral papilledema and a slight right central facial weakness. Cerebro-spinal fluid obtained by lumbar tap was clear and colorless and under a pressure of 50 mm. of water. Plain x-rays of the skull were negative. However, x-rays taken after the injection of air by ventricular puncture showed a shift of the entire ventricular system to the right. In addition, the body of the left lateral ventricle was depressed (Fig. 1). A left parietal craniotomy disclosed a typical subdural hematoma, and its removal was followed by rapid and complete recovery.

[1] This is one of a series of papers contributed by friends and former pupils of I. Seth Hirsch, M.D.

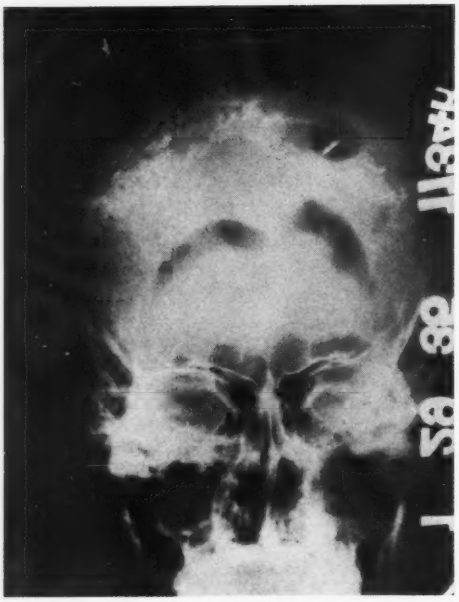

Fig. 1. Case 2. Showing displacement of the entire ventricular system to the right, and depression of the body of the left lateral ventricle.

Case 3. White male, aged 45 years, admitted in coma, March 12, 1936. Two weeks before he had been kicked in the head during a brawl. Following this, he became confused and incoherent, and a few days later very drowsy. When roused, he complained of severe right frontal headache. The day before admission the patient became deeply comatose, and remained so. On admission, his pulse rate was 50. The upper extremities were both spastic, and the Babinski sign was positive on both sides. Lumbar puncture yielded a clear colorless fluid under a pressure of 180 mm. of water. While in the hospital the patient had a convulsion involving the right upper extremity, accompanied by turning of the head and eyes to the right. The right pupil became larger than the left. Consent for operation was withheld for 24 hours. During this interval several convulsions occurred. At operation, a large, well encapsulated subdural hematoma was found and removed. The patient did not rouse from his coma and expired 48 hours later.

Case 4. White male, roofer, aged 44 years, received a blow to the head. He was unconscious for an unknown period, but returned to work the next morning. Two weeks later he had a sudden attack of dizziness and headache. After three days in bed he felt well again, but when he attempted to return to work the headache reappeared and he vomited several times. When examined three weeks after his head injury he was very drowsy, the pulse rate was 40, and there was a left central facial weakness and increase in the tendon reflexes of the left upper extremity. Blood pressure was 140/80. The spinal fluid was clear and colorless and under a pressure of 140 mm. of water. At operation, an encapsulated subdural hematoma, containing a chocolate-colored fluid, was found on the right side. The patient's headache was relieved at once and he made a rapid recovery.

Case 5. White female, aged 49 years, who struck her head three days previously while under the influence of alcohol. She was unconscious for a brief period at that time, but seemed to have suffered no serious injury until three days later when she became drowsy and confused. When examined in the hospital, she had a slightly stiff neck, and her pupils reacted sluggishly to light. The pulse rate was 64 and the blood pressure 162/110. Spinal puncture yielded a xanthochromic fluid under a pressure of 70 mm. of water. Seven days after her injury the patient had a Jacksonian seizure involving the right side of the face and the right upper and lower extremities. Following this episode, stupor deepened and the reflexes on the left side were increased. There was a positive left Babinski. X-ray examination of the skull revealed a linear fracture in the right temporal region. At operation, a large subdural hematoma containing a currant-jelly clot was found on the left side. The patient did not improve, and died 24 hours later.

Case 6. White male, aged 52 years, was struck by an automobile while intoxicated, and brought to the hospital in coma, bleed-

ing from the left ear. The reflexes were absent and a weakness of the left side was evident. The patient improved slowly until the eighth day after his injury when he became more drowsy, the left hemiparesis increased, and the Babinski sign became positive on both sides. The spinal fluid was bloody and under increased pressure. X-ray examination of the skull was negative. Bilateral trephine exploration was done. A right subdural hematoma was found and evacuated. This was followed by a rapid return of power in the left upper and lower extremities, and the patient left the hospital four weeks after the operation in good condition.

Case 7. White male, aged 38 years, was admitted to the hospital in deep coma. He was said to have been in a fight two weeks previously: he became comatose the day before admission to the hospital. On examination, the pulse varied from 56 to 60 per minute. The right pupil was dilated and fixed to light. There was a left hemiparesis, with a left positive Babinski. The optic discs were normal. Spinal tap yielded a clear fluid. The pressure was 260 mm. of water. At operation, a large subdural hematoma containing fluid and clot was found on the right side. There was no improvement following this procedure, and the patient died 24 hours later.

Case 8. White male, aged 52 years, was brought to the hospital in stupor. One month previously, while intoxicated, he fell to the sidewalk and was unconscious for several hours. This was followed by headache and vomiting of one day's duration, and a generalized convulsion followed by stupor. On admission, the patient was stuporous, but could be roused for short intervals to answer questions. His pulse rate was 66 and blood pressure 140/110. Bilateral early papilledema was found. There was also a left central facial weakness and a left hyper-reflexia. X-ray examination of the skull was negative. At operation, a right subdural hematoma was found and evacuated. The patient did not improve and expired 12 hours after the operation.

Case 9. White male, aged 14 years, fainted while in the bathtub. In falling, he struck his head against the side of the tub. Following this he complained of a dull pain over the left eye. Within a few weeks the pain increased in severity and was accompanied by spells of drowsiness. Two weeks before coming to the hospital the patient had diplopia, blurring of vision, and tingling in the fingers of the left hand. On admission, he was alert and well oriented. Bilateral papilledema of four to five diopers was present, along with a slight left external rectus palsy. The spinal fluid was clear, colorless, and under a pressure of 380 mm. of water. The patient was suspected of having a cerebral neoplasm. Frontal ventriculography failed to visualize the cerebral ventricles. Encephalography showed a displacement of the entire ventricular system to the right. The body of the left ventricle was depressed and its normal curved contour flattened. Trephine exploration revealed a left subdural hematoma. Following operation, the papilledema receded, and the patient returned to school, but he continued to have occasional headaches.

Case 10. White male, aged 44 years, was admitted to the hospital in deep coma. Two months previously he began having severe headaches, accompanied by vomiting. After two weeks he was forced to quit his job as a chef, he gradually became more and more lethargic, and his memory became markedly impaired. A few days before admission he became very drowsy, and finally comatose. Except for the deep coma, the neurological examination was essentially negative. The fundi were normal. Spinal tap yielded a clear colorless fluid under a pressure of 110 mm. of water. The pulse rate varied between 50 and 60. Frontal ventriculography was done, but the ventricles failed to fill properly. Lumbar encephalography was likewise unsatisfactory. Bilateral posterior parietal trephine exploration disclosed a bilateral subdural hematoma. Operation was followed

TABLE I.—SUMMARY OF FINDINGS

Case	Injury	Onset of Symptoms	Time of Operation	Headache	Stupor	Pupils	Fundi	Focal Signs	Pulse Rate	Spinal Fluid	Spinal Fluid Pressure	X-ray of Skull	Side of Lesion	Result
1, f., 48	Fist blow to head	Unknown	5 weeks	Not known	Marked	Left dilated	Discs blurred	Right hemiparesis	60	Clear and colorless	Slightly increased	Negative	Right	Cured
2, m., 25	Struck on jaw	12 days later	7 weeks	Severe	None	Normal	Choked discs	None	80	Clear and colorless	500 mm. of water	L. ventricle displaced	Left	Cured
3, m., 45	Kicked in head	Immediate	2 weeks	Severe	Deep coma	Right dilated	Normal	Right side spastic	50	Clear and colorless	180 mm. of water	Negative	Left	Died
4, m., 44	Blow to head	2 weeks	3 weeks	Severe	Marked	Normal	Discs blurred	Left hemiplegia	40	Clear and colorless	140 mm. of water	Negative	Right	Cured
5, f., 49	Fell on head	3 days	8 days	Not known	Marked	Normal	Normal	Reflexes increased on left	64	Xantho-chromic	70 mm. of water	R. temporal fracture	Left	Died
6, m., 52	Struck by auto	Immediate	8 days	None noted	Marked	Normal	Normal	Left hemiplegia	72	Bloody	Slightly increased	Negative	Right	Cured
7, m., 38	Fist fight	Not known	2 weeks	Not known	Marked	Right dilated	Normal	Left hemiparesis	56	Clear and colorless	260 mm. of water	Negative	Right	Died
8, m., 52	Fell to sidewalk	1 week	4 weeks	Marked	Marked	Normal	Early choking	Reflexes on left increased	66	Xantho-chromic	Slightly increased	Negative	Right	Died
9, m., 14	Fell in bathtub	Immediate	3 months	Moderate	None	Normal	Choked discs	None	72	Clear and colorless	380 mm. of water	Ventricular shift to R.	Left	Cured
10, m., 44	Not known	Not known	2 months	Marked	Deep coma	Small equal	Normal	None	50	Clear and colorless	110 mm. of water	Negative	Bilat-eral	Cured
11, f., 50	Fell down stairs	9 days	9 days	Moderate	Marked	Left large	Normal	Left hemiparesis	100	Xantho-chromic	Increased	R. temporal fracture	Left	Cured
12, f., 42	Struck by auto	4 days	17 days	Moderate	Marked	Right dilated	Normal	Left hemiparesis	56	Xantho-chromic	80 mm. of water	Negative	Right	Cured

by rapid recovery, although during the first few days the patient was markedly confused and disoriented. He eventually cleared up entirely, and, when examined at the time of discharge, he was fully oriented and seemed normal mentally.

Case 11. White female, aged 50 years, who, after falling down a flight of stairs, was unconscious for an hour. She was removed to a hospital, where bleeding from the right ear was noted, and an x-ray examination of the skull disclosed a fracture in the right temporal region extending into the base of the skull. There was a right peripheral facial weakness at this time. The patient improved rapidly and was thought to be well on the way to recovery, when, on the ninth day post-trauma, she became comatose. Examination at this time revealed a peripheral right facial weakness, a left spastic hemiparesis, bilateral Babinski, sluggish pupils with the left somewhat larger than the right. The pulse rate was 100. Spinal fluid was tinged yellow, and the pressure, though not measured, was reported as "elevated." Bilateral fronto-temporal trephine exploration revealed a left encapsulated subdural hematoma containing a large amount of chocolate-colored fluid and some solid clot. The patient awoke from her coma on the operating table, and made a rapid recovery.

Case 12. White female, aged 42 years, was struck down by an automobile and removed to the hospital. She had a laceration in the right frontal region which was sutured. A spinal puncture done soon after the injury yielded a bloody fluid which was under a pressure of 110 mm. of water. She rapidly recovered from the immediate effects of the injury and seemed well on the way to recovery. After four days she began to complain of headaches. On the fifteenth day after the injury she became stuporous. Her pulse was slow, there was a weakness of the left upper and lower extremities, and a positive Babinski on the right. The fundi were normal. A spinal tap at this time gave a yellow, clear fluid. The pressure was 110 mm. Bilateral temporo-frontal trepination was done. An encysted subdural hematoma was found on the right side. After its evacuation the patient made a rapid and uneventful recovery.

DISCUSSION

Many reports (3,4,5) concerning traumatic subdural hematoma have appeared in recent years so that typical cases rarely escape detection. However, variations in the clinical picture have not been stressed and misconceptions concerning the importance of some of the signs and symptoms are prevalent.

In this series, four of the twelve patients were female. The average age was 38 years, the youngest patient was 14, the oldest 52. Most of the patients received direct blows to the head. In one case there was no history of an accident. Five were injured in fights, one fell in the bathtub, one fell to the sidewalk, two fell downstairs, and two were pedestrians who were struck down by automobiles. In only three cases was the injured person considered so seriously traumatized at the time of the accident that he was removed to a hospital. In the other cases, hospitalization was not considered necessary until several days or weeks later. The earliest operation was done eight days after the known injury: an average of about three and one-half weeks elapsed from the date of the accident to the time of operation: the longest interval was three months. In one case, in which a history of trauma was not obtained, operation was done two months after the onset of symptoms. In every case but one, in which it was possible to obtain a history, headache was present. In three cases no history was available. Alteration in the state of consciousness was present in 10 of the 12 cases. The four patients who died were in profound coma at the time of operation. Six were in stupor, but could be roused slightly on painful stimuli: two had no alteration in the state of consciousness. Convulsive seizures could be attributed to the lesion in only one case. In another

patient who had frequent seizures while under observation there was a long-standing history of convulsions, while a third who had convulsions was a chronic alcoholic of many years' duration.

In eight of the 12 cases the pulse rate was abnormally slow: the remaining four had normal rates. There were no constant alterations of blood pressure, which in most cases was within normal limits. In three patients a dilated pupil was found on the side of the lesion, while two had the large pupil on the normal side. In seven cases the pupils were equal in size. In six cases hemiplegia and increase in reflexes were found contralateral to the lesion, and were of aid in localization. In three cases a hemiplegia was found on the side of the lesion. In the remaining cases the reflexes were equal.

Two patients had severe papilledema at the time of admission and were at first suspected of having brain tumors. One patient who was deeply comatose on admission had early papilledema. In two cases the disc margins were blurred, and in the remaining seven the fundi were normal.

The cerebrospinal fluid was clear and colorless in seven cases; in four it was xanthochromic, and bloody in one. The pressure was determined with a water manometer in eight patients: in four it was 180 mm. or higher; in four, less than 180 mm., and in the remaining four, in which a manometer was not used, it was estimated as "increased" or "slightly increased."

The subdural hematoma was on the right side in six cases, on the left in five, and bilateral in one. X-ray examination of the skull was normal in ten cases. In the remaining two, right temporal fractures were found. Ventriculography was employed on three occasions and encephalography twice in three patients in whom the diagnosis was in doubt. In one case satisfactory ventricular filling was obtained after unilateral occipital puncture. In another, bilateral frontal ventriculography was unsuccessful, but satisfactory ventricular filling was obtained by encephalography. In a third case in which airograms were deemed necessary for diagnosis, both frontal ventriculography and encephalography failed. When burr holes were made in the posterior parietal regions for the purpose of injecting air into the ventricles, a bilateral subdural hematoma was found and air injection was obviated.

In the two cases in which satisfactory ventricular filling was obtained, both showed displacement of the ventricular system to the opposite side and flattening and depression of the body of the ventricle on the side of the lesion.

CONCLUSION

The diversity of signs and symptoms in this series indicates the futility of attempting to formulate a rigid clinical syndrome describing subdural hematoma. X-ray examinations of the skull are most often negative in patients with subdural hematomas. While the diagnosis most often depends on trephine exploration, in some cases ventriculography may be necessary. Occasionally it is difficult to secure filling of the ventricles either by the ventricular or lumbar routes. Films taken after successful ventricular filling show a displacement of the ventricular system away from the lesion and a depression and loss of the rounded contour of the body of the ventricle on the side of the lesion.

It is evident that subdural hematoma must be given a prominent place in the consideration of every patient admitted to the hospital in coma, especially if a history of antecedent trauma to the head is obtained. If, in addition, the pulse rate is slow, and other causes such as diabetes, uremia, and poisoning have been eliminated, exploration for a subdural hematoma is urged.

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ANEURYSM OF THE PULMONARY ARTERY[1]

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AS Edens (1) says, in his classical work about heart disease, aneurysm of the pulmonary artery was mentioned by Morgagni (2), and yet most of our modern textbooks contain only brief mention of this interesting disease.

The few cases described in the literature are repeatedly collected and critically judged. Studying these reports, we must confess that only very few of the reported cases are contributing much about the cause, development, and clinical picture of pulmonary aneurysm. Either the history or the clinical data are missing in many of these descriptions.

First of all, it is necessary to distinguish between the *aneurysm*—the sac-like dilatation *of a part of the pulmonary artery*—and the *multiple dilatations of large arteries of the lungs*. These diverticulum-like dilatations do not seem to be rare, but clinically they do not lead to important symptoms. A third group, which must be separated from the others, is the *diffuse dilatation of the truncus arteriæ pulmonalis*, seen in the x-ray film as a bulging of the pulmonary arch of the heart shadow. We find it frequently in cases of a patent ductus Botalli, in cases of stasis in the pulmonary circulatory tract, especially in cases of mitral stenosis, in cases of insufficiency of the pulmonary valves, and, infrequently, in cases of congenital stenosis of the pulmonary valves. Films of such cases may be seen in the writer's various publications (3, 4, and 5), and in Maude E. Abbott's Atlas of Congenital Heart Disease (40). This diffuse dilatation of the pulmonary artery may be compared with the diffuse dilatation of the aorta which we find regularly in cases of insufficiency, but also occasionally in cases of stenosis of the valves of the aorta.

Medical literature does not give us this threefold division—aneurysm, diffuse dilatation of the arteria pulmonalis communis, and multiple dilatations of the arteriæ pulmonales—therefore, the *exact number of thus-far-published cases* of true aneurysms can hardly be estimated. The fact is that less than one hundred cases were mentioned under this diagnosis within the last one hundred years. Henschen (6) collected 46 cases up to 1906, Posselt (7) collected 26 more up to 1909, Käppeli (8) added 21 in 1933, and since then Esser (9) has reported one case and B. S. Oppenheim (39) seven cases. But, as mentioned before, *only a few of these cases seem to be real aneurysms.*

Roentgenologically examined cases are described by Weinberger (10), Horn (11), Balaban (12), Rosenfeld (13), Spitzer (14), Hoffmann (15), Poinso (16), Kranz (17), Käppeli in collaboration with Lüdin (18), B. S. Oppenheim (39), and some others, perhaps, but only five of these cases (Poinso, Kranz, Weinberger, Käppeli-Lüdin, and Oppenheim) were verified by autopsy.

The rarity of this disease, which could never be overlooked anatomically, can obviously be seen in the fact that Costa (19) found only one case among 2,000 autopsies and Käppeli only one among 8,000. It appears that there are about four aneurysms of the pulmonalis compared to 1,000 aneurysms of the aorta.

As mentioned before, the reports in the literature about the patients with pulmonary aneurysms are so incomplete that we can hardly come to a definite conclusion about the genesis.

According to Boldero (20), sclerotic and, first of all, inflammatory changes very seldom are causal factors, because inflammatory processes are seldom in the region of the pulmonary arteries, due to the venosity of the blood.

[1] This is one of a series of papers contributed by friends and former pupils of I. Seth Hirsch, M.D.

On the other hand, syphilitic changes more frequently seem to be the cause of aneurysms in the pulmonary arteries. But, at the same time, we must consider that syphilis of the arteriæ pulmonalis is a comparatively rare occurrence.

Most of the authors assume congenital alterations of the vessel as a primary cause of the aneurysm of the pulmonary aorta. B. S. Oppenheim (39), for instance, reported about seven cases of congenital hypoplasia of the vessel walls. Here, too, we must mention that, for instance, cases with a persisting ductus Botalli are included under the classification of aneurysm of the pulmonary artery.

The increased pressure in the vessel is mentioned as a frequent cause; and here, again, the cases of mitral stenosis, etc., are included.

But on one point most of the authors agree; it seems almost always necessary for two causal factors to coincide to cause the formation of an aneurysm.

So we may, with Käppeli, list the cases described in the literature in the following way, but once more we must mention that many of these cases cannot be accepted as real aneurysms.

I. Congenital anomalies of the vessels
   1. Patent ductus Botalli (Krzyszkowski, 21; Hoffmann, 15; Kranz, 17; Horn, 11; Moench, 22; Lexow, 23; Groedel, 3, 4, and 5; Abbott, 40).
   2. Unequal division of the truncus arteriosus communis.
   3. Congenital narrowness of the small pulmonary arteries.
   4. Malformations, especially hypoplasia, of the walls of the vessels (Costa, 19; Esser, 9, and B. S. Oppenheim, 39).

II. Hypertension in the pulmonary circulatory system
   1. Valvular diseases, especially mitral stenosis and (Dlauhy, 24; Gilewski, 25; Conti, 26; Spitzer, 14, and Groedel, 3, 4, and 5).
   2. Defect of the septum (Baumgartner, 27).
   3. Perforation of an aortic aneurysm into the arteria pulmonalis (Weinberger, 10).
   4. Cirrhotic processes in the lungs, emphysema, tumors (Storch, 28; Ducach, 29; Dlauhy, 24, and Conti, 26).
   5. Stenosis of the pulmonary vessels (Lissauer, 30).
   6. Pulmonary sclerosis.
   7. Compression of the pulmonalis by an aortic aneurysm (Costa, 19).

III. Pathological changes of the arterial walls
   1. Syphilis (Barth, 31; Garreton, 32; Plenge, 33; Neuburger, 34, and Storch, 28).
   2. Tuberculosis (only in the small vessels).
   3. Other infective processes (Wildhagen, 35; Sherman, 36; Hoeldmoser, 37, and Therplan, 38).
   4. Organic changes of old age (Storch, 28, and Käpeli, 8).
   5. Traumas (Balaban, 12).

IV. Retractions from scars.

One such interesting case is published in the fourth edition of Groedel's "Atlas der Röntgen Diagnostik," illustration 359, Munich, 1924.

When we come to consider the clinical symptoms of pulmonary aneurysm we are again impressed by the lack of data in the literature. The symptoms, like those of aortic aneurysm, seem to be in one case very distinct, in another perhaps altogether lacking. We find mentioned most frequently bulging of the second and third left cartilage of the ribs, pulsation in the second left intercostal space, and systolic vibration.

At the same time, the lack of certain symptoms characteristic of an aneurysm of the aorta may be called very typical for the aneurysm of the pulmonary aorta, such as pulse differences, etc. But most important are the x-ray findings. In discussing the differential diagnosis, they may lead to

the final decision, but they do not always do so.

In regard to the differential diagnosis, we must consider the following conditions:

1. Tumors in the left hilus region, especially benign types, such as echinococcus and dermoid cysts, but also slowly growing malignant tumors.
2. Congested hilus, for instance, in siderosis, in severe chronic bronchitis and, first of all, in congestion of the pulmonary circulatory system.
3. Patent ductus Botalli and other congenital malformations.
4. Distortion of the artery through pleurisy and other pulmonary scars.
5. Primary pulmonary sclerosis.
6. Perforation of an aortic aneurysm into the pulmonary artery.
7. Aneurysms of the inner arch of the ascending aorta (especially important and difficult to recognize).

The case of Mr. C. will show how difficult it is, if not often impossible, to come to a conclusion about these questions of differential diagnosis.

The patient, a plantation owner, 42 years old, lives in South America at an altitude of 2,600 meters. His mother died at the age of 45 of an intestinal disease; his father enjoyed especially good health and died in his sixty-sixth year, of pneumonia. Both grandfathers died in their seventies, from carcinoma; one brother died of carcinoma of the rectum at the age of 43; one brother and two sisters are healthy. The patient did not drink much and smoked an average of thirty cigarettes a day. There was no history of syphilis. Wassermann reaction and lumbar puncture were always negative. He had always been healthy until about 1930, when he was examined in Paris because of indigestion (vomiting spells). Not until May, 1935, was this indigestion found to be caused by gallstones.

On the same occasion (1930), when the stomach was examined by the x-ray, a peculiar shadow was observed above the

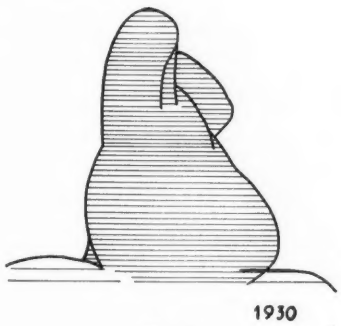


Fig. 1.

heart. According to the copy of a film made at that time (Fig. 1), a sharply outlined, curved shadow was seen in the region of the pulmonary arch of the left border of the heart. This shadow extended beyond the heart shadow by about two or three centimeters, running parallel to the pulmonary arch. Could we not have seen the pulmonary arch itself, we would have guessed that this shadow was the dilated pulmonary arch. A bismuth treatment was prescribed. After the treatment, the physician told the patient that the shadow had disappeared. But in a film made in 1931, we find the same shadow again, and this time it extends beyond the pulmonary arch by about four to six centimeters. The diagnosis of aneurysm of a syphilitic origin was again made and further bismuth treatment recommended.

When the gallstones were found, in May, 1935, and an operation considered necessary, the heart was re-examined. This time the diagnosis of a lung tumor was made. On four consecutive days heavy x-ray treatment was given, but, because the shadow had not changed in size after four weeks, a chest operation was recommended. Only one day before the date of the operation, another chest examination was made and, because the strange shadow pulsated slightly, the operation was cancelled. A mercury inunction treatment was recommended instead.

When I saw the patient for the first time, in 1935, he had no subjective symptoms whatever, except for a sensation of slight pulsation in the region of the second and third cartilages of the ribs, during moments of great excitement. A very careful and repeated clinical examination of the patient revealed absolutely negative findings in every respect; especially blood pressure, heart sounds, and electrocardiogram showed no alteration.

But the x-ray examination of the chest organs showed a distinctly changed film, compared with 1930 and 1931.

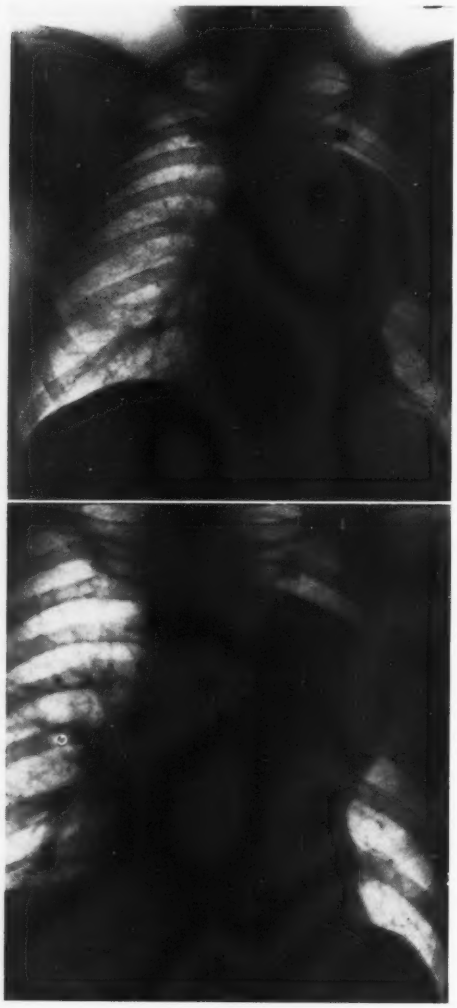


Fig. 2 (*upper left*).
Fig. 4 (*lower left*).

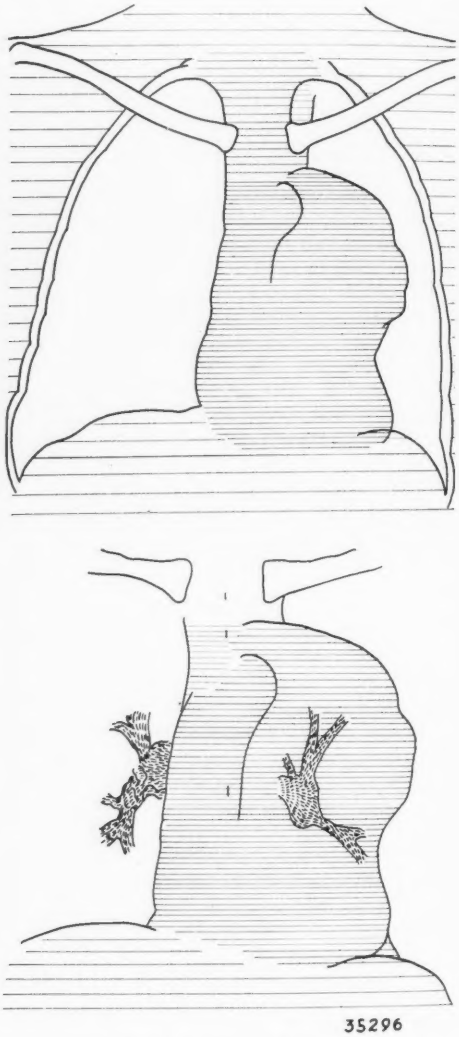


Fig. 3 (*upper right*).
Fig. 5 (*lower right*).

Figure 2 is a dorsoventral sagittal film and, like all the others, taken at 180 cm. focus-plate distance, $^1/_{20}$ second exposure time, 200 milliamperes, and averaging 75 kilovolts. This film shows well-expanded lungs, correctly situated left and right diaphragm, and slightly increased hilus shadow. On the right side of the vertebral

column, the heart shadow is hardly distinguishable; in other words, the heart is slightly displaced to the left side. The left lower arch of the heart shadow, corresponding to the left ventricle, shows only slightly increased measurements, and seems to be flattened. Above this lowest left arch of the heart shadow, we see a round shadow coming out of the heart shadow, covering the middle part of the left lung, sharply outlined against the lung, and two slight indentations showing. No details of the heart shadow, covered by this large shadow, can be distinguished; only the arch of the aorta and the ascending aorta can be seen distinctly. The ascending aorta and the arch are of normal size, perhaps even a little subnormal for the patient's age. But the big shadow is not altogether homogeneous; in the middle of it we see a large shadow shaped somewhat like a butterfly. These details can be seen in Figure 3 (a drawing from Figure 2).

In order to show up the details of the heart shadow more clearly, we used another technic; we put the patient 40 centimeters away from the plate so that the entire shadow became enlarged on the plate. The results are seen in Figure 4. Here, too, we recognize the different facts, namely, that the right border of the heart shadow scarcely exceeds the right border of the vertebral column, that the left ventricle cannot be much larger than normal; we distinguish here more clearly the shadow of the ascending aorta through the tumor shadow, and we may now decide that the butterfly-shaped shadow in the center of the tumor shadow corresponds exactly (in regard to distance from the middle line, configuration, etc.) to the left hilus shadow. All these facts are shown in Figure 5, which is a drawing made from Figure 4.

If we make a ventrodorsal sagittal film (Fig. 6), we obtain exactly the same details as just mentioned, but the tumor shadow appears a little larger, which indicates that the tumor must be nearer to the anterior chest wall than to the back.

So far, the following factors are apparent: the ascending aorta appears perfectly normal, the left ventricle does not seem to be much larger than normal; the right ventricle and the pulmonary artery cannot be

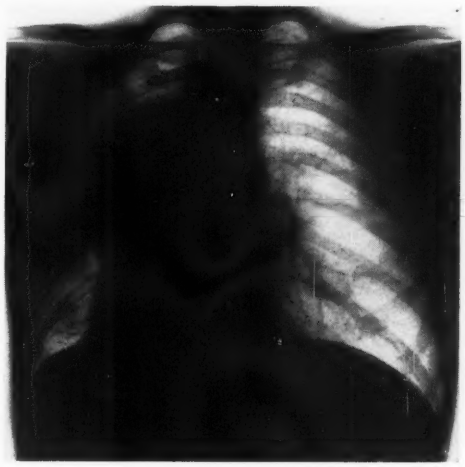
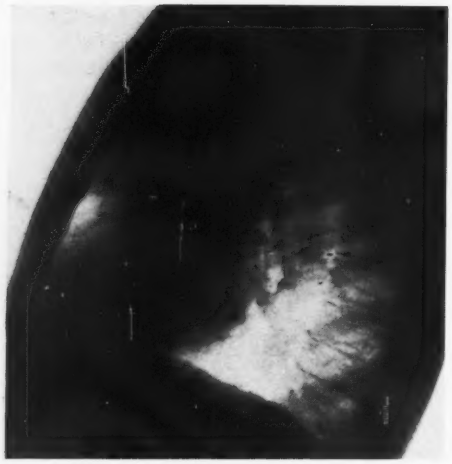


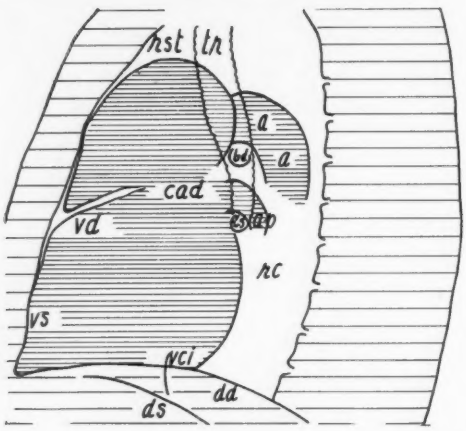
Fig. 6.

seen in these films; the tumor has about the same absorption quality as the heart; the tumor throws a homogeneous shadow through which the details of the lung can be distinguished; the tumor must be situated nearer the anterior chest wall than it is to the back.

Of greatest importance is the dextrosinistral lateral exposure of the chest which is shown in Figure 7, and in Figure 8, a drawing made according to this film. For comparison, I add, in Figure 9, the drawing of a lateral exposure of a normal person. In this and in the figures, the letters have the following meaning:

tr, trachea.
b s, left main bronchial tube.
b d, right main bronchial tube.
a, aorta.
r st, retrosternal space.
r c, retrocardial space.
p s, left lung.
p d, right lung.
d s, left diaphragm.
d d, right diaphragm.
v s, left ventricle.
v d, right ventricle.
a s, left auricle.





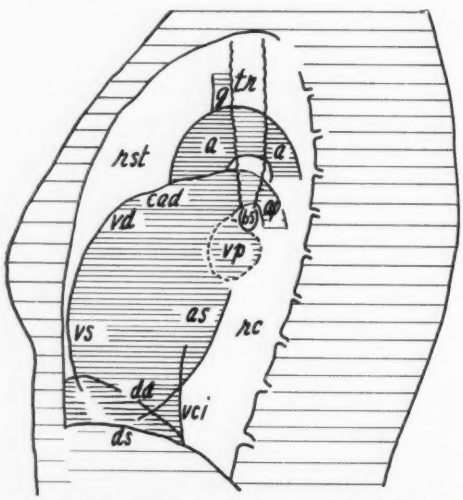


Fig. 7 (*upper*). Fig. 8 (*center*). Fig. 9 (*lower*).

a d, right auricle.
c a d, conus arteriosus dexter.
a p, arteria pulmonalis.
v p, vena pulmonalis.
g, great vessels.
v c i, vena cava inferior.

Studying the lateral x-ray film of our patient, the following facts are revealed: The lungs are normal in this direction, too, as well as both parts of the diaphragm. The heart shadow is distinctly dilated in its depth, being displaced somewhat downward but, at the same time, the shadow is markedly enlarged upward, filling up the retrosternal space more than is normal, which distinctly indicates an increased volume of the right ventricle. The heart shadow can be followed in the normal way up to the point of the conus arteriosus. The conus arteriosus and the shadow of the ascending aorta, which generally cross at this point under normal conditions, cannot be seen; instead of this, the heart shadow without interruption goes over into the tumor shadow, while the shadow of the right ventricle appears a few millimeters below the limits of the shadow. The borderlines of the shadow are sharp. They follow first the shadow of the sternum, they then make a big curve crossing the shadow of the trachea, coming back to the point of the conus arteriosus. The shadow of the tumor, as a whole, grows out of the heart shadow like a mushroom, with its stem attached in the region of the conus arteriosus.

Further, the lateral film shows distinctly, and unaltered, the shadow of the left arteria pulmonalis of the arch and the beginning of the descending aorta.

In addition to this film, Figure 10 demonstrates that the course of the esophagus, which is filled with opaque material, is entirely unaltered. Details can be seen in Figure 11, which shows the drawing made from Figure 10.

The important facts to be concluded from the lateral films are: the tumor shadow is connected with the heart shadow in the region of the conus arteriosus, the back of the arch and the descending aorta

have no connection with the tumor shadow; the divisions of the pulmonary arteries appear perfectly normal; the trachea and oblique diameter. If we compare the drawing of this film, as shown in Figure 19, with the drawing of a healthy man (Fig. 20), we

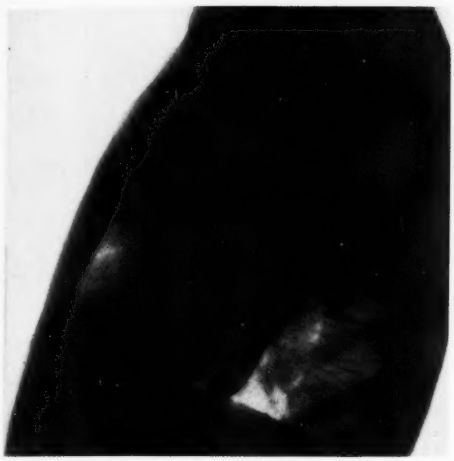


Fig. 10.

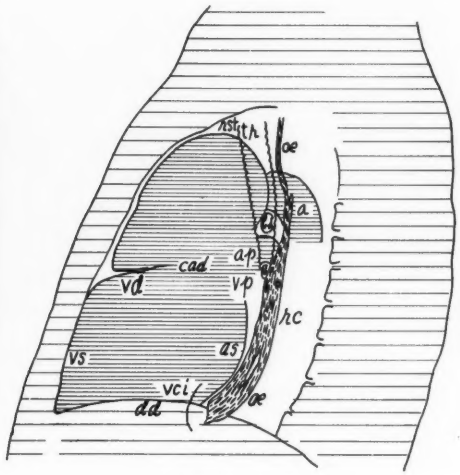


Fig. 11.

esophagus are not displaced and remain unaltered in their forms.

Compared with the findings of the films taken in the sagittal and lateral positions, those we obtain from the films taken in the oblique diameters are of minor importance. Figure 12 is the film taken in the dorsoventral first oblique diameter. Figure 13 is an exact drawing of Figure 12, and Figure 14 is the drawing of the film of a normal person, taken in this position.

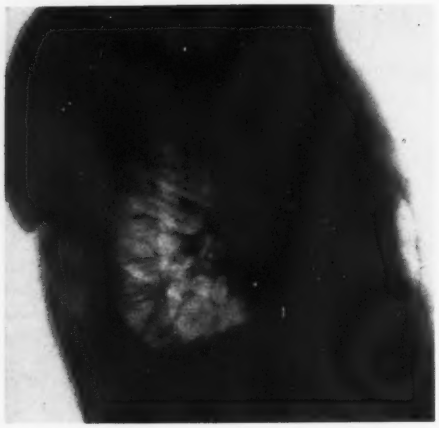
We find again that the tumor shadow is situated directly over the right ventricle, that there is no connection with the arch of the descending aorta or with the main branches of the pulmonary artery, and that there is no displacement or even connection with the trachea.

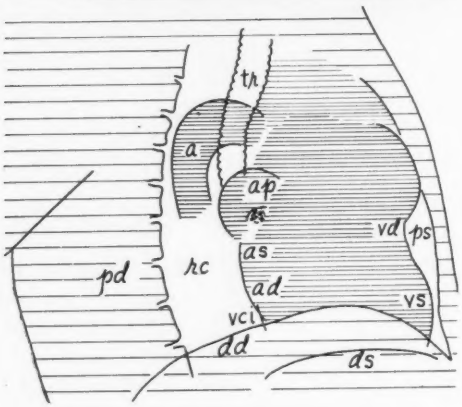
Figure 15 is taken in the ventrodorsal first oblique diameter. The details, which show the same facts but not as distinctly as in the dorsoventral diameter, can be seen in Figure 16, a drawing of the film. For comparison, I add the drawing of the film of a normal person (Fig. 17).

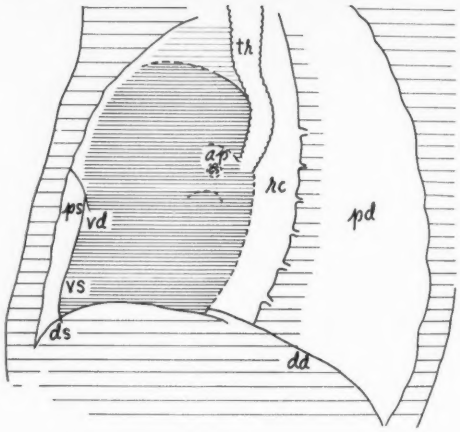
More interesting is Figure 18, which shows the heart in the second dorsoventral will recognize the following facts: the tumor is situated above the heart shadow close to the right ventricle on the front side, and close to the right auricle at the back, covering the trachea and the two main bronchial tubes, which can be recognized through the tumor shadow. The main branch of the arteria pulmonalis and the descending aorta are not connected with the tumor.

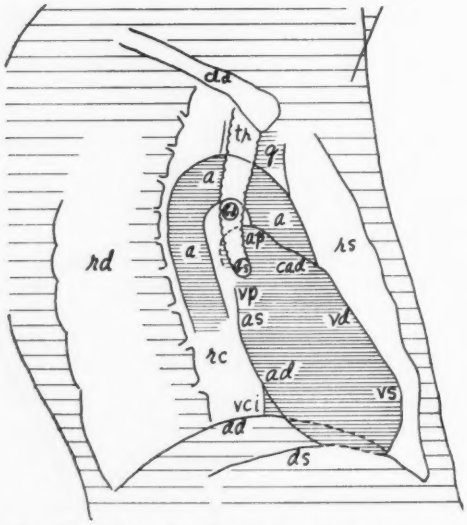
In mirror-like reversal, we find the same details in Figure 21, which is made in the second ventrodorsal oblique diameter. Details will be recognized in Figure 22, the exact drawing of the film. Figure 23, the drawing of a normal individual, is shown for comparison.

As I mentioned before, the films taken in the oblique diameter cannot add anything of importance to the facts which were learned from the films taken in the lateral and sagittal positions, but they will show that the tumor is connected with the upper part of the right ventricle, changing its position in the same way as the right ventricle does when we revolve the body on its axis. Further, we discover also, by exami-









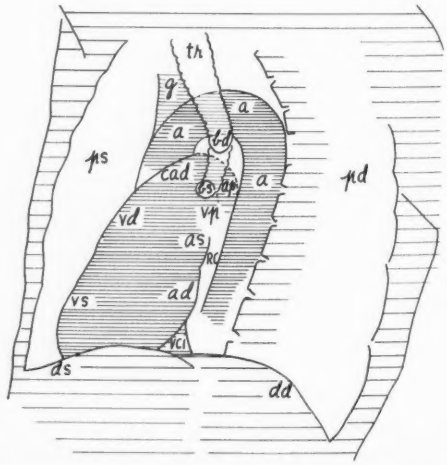
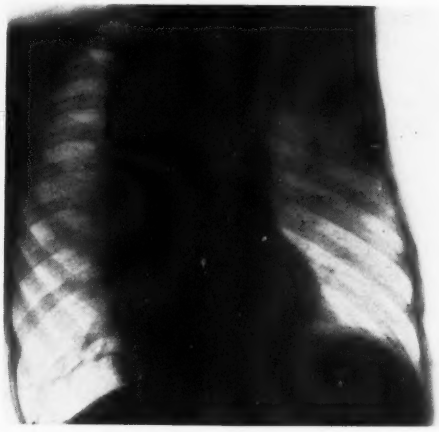
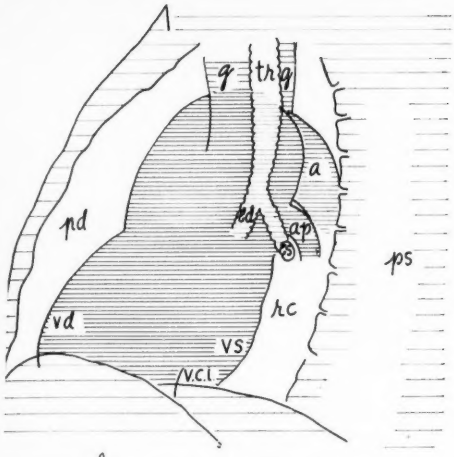


Fig. 12 (*upper*). Fig. 13 (*center*). Fig. 14 (*lower*).

Fig. 15 (*upper*). Fig. 16 (*center*). Fig. 17 (*lower*).





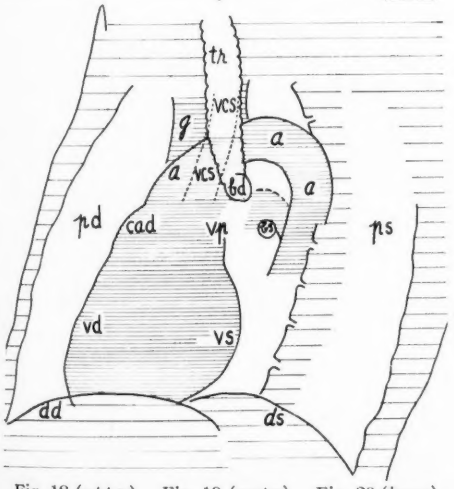
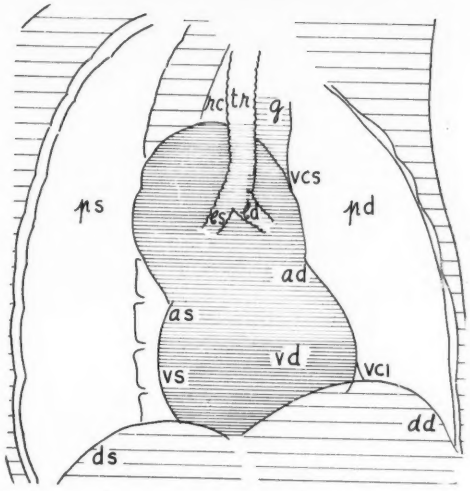


Fig. 18 (*upper*). Fig. 19 (*center*). Fig. 20 (*lower*).



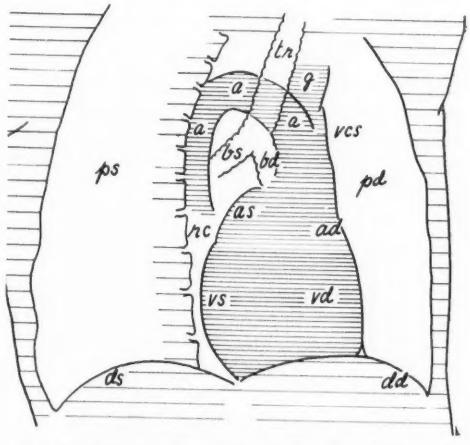


Fig. 21 (*upper*). Fig. 22 (*center*). Fig. 23 (*lower*).

nation in these diameters, that we find no connection of the tumor with any other part of the heart, or of the large vessels, or with any other thoracic organ, or its parts.

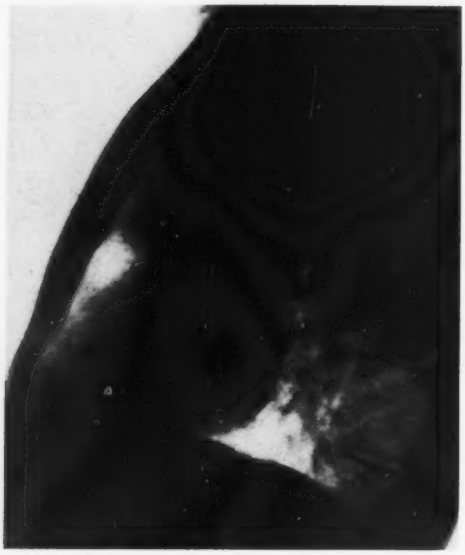


Fig. 24.

I believe that the situation will appear even more clear in Figure 24, in which the lateral exposure is taken at 40-centimeter distance between the body and the plate.

I think there can be no doubt that the tumor is connected with the heart, and that this connection is in the region of the upper part of the right ventricle, either at a point below the pulmonary valves (conus arteriosus) or above the pulmonary valves (pulmonary artery). A connection with the ascending aorta, especially with its inner arch, may be excluded by the sagittal films; a connection with the arch of the aorta or with the descending aorta may be excluded by the lateral films, and a connection with the main divisions of the pulmonary artery or any other part of the heart or of the other thoracic organs is excluded by all of the films.

We have so far excluded any kind of formation outside the heart, and we may take it for granted that the tumor is connected with the circulatory system. We excluded a connection with the aorta ascendens, especially its inner arch, with the arcus and descending aorta. We ascertained that the tumor is connected either with the conus arteriosus or the stem of the pulmonary artery.

What can be the nature of the tumor? There are only three possibilities: (1) heart aneurysm (conus arteriosus); (2) tumor of the heart; (3) aneurysm of the stem of the pulmonary artery.

An aneurysm of the heart cannot be absolutely excluded. But it is hardly believable that a heart aneurysm could ever assume such proportions without having ruptured long before. At least its pulsations should be violent.

A tumor of the heart should have shown some reaction to the x-ray treatment, because a heart tumor is generally of the radiosensitive type. Further, a tumor should show a "riding" pulsation; in other words, a tumor pulsates in just the same way as the part of the heart to which it is connected.

An aneurysm of the stem of the pulmonary artery should show an alternating pulsation with the right or left ventricle, because the aneurysm fills up just like the main vessels leaving the heart, while the systolic contraction of the heart takes place.

What did the roentgen kymographic plates show? Since I did not have my apparatus available, I asked Dr. I. Seth Hirsch and Mr. Schwarzschild to take the kymograms of my patient (Mr. C.). The result found was: the pulsations of the heart are of normal quality, the pulsation of the tumor is extremely weak. But, in spite of the tumor's weak pulsation, we can distinctly prove that the pulsation of the tumor alternates completely and constantly with the pulsation of the left ventricle and the right lower arch of the heart shadow which, of course, shows the transmitted pulsation of the right ventricle (Figs. 25 and 26). Hence there is no doubt that the shadow which is distinctly connected with the upper end of the right ven-

tricle is not caused by a heart tumor, nor by a heart aneurysm, but by an aneurysm of the stem of the pulmonary artery.

After three years' interval, the patient returned to my office. He told me that he first continued the bismuth treatment and remained in the high altitude, but then started to feel his heart. He suffered from shortness of breath and coughed considerably, especially at night or when lying

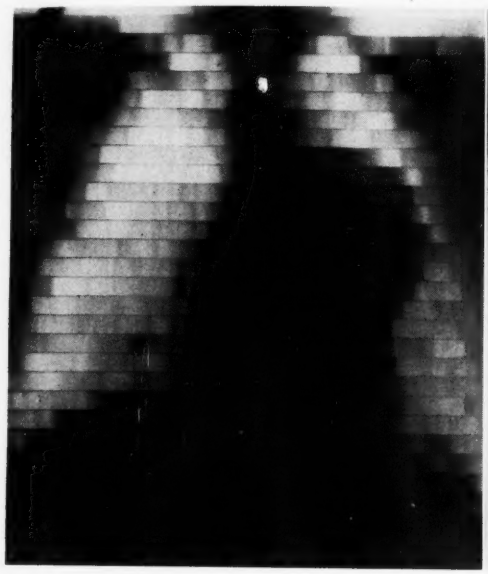


Fig. 25.

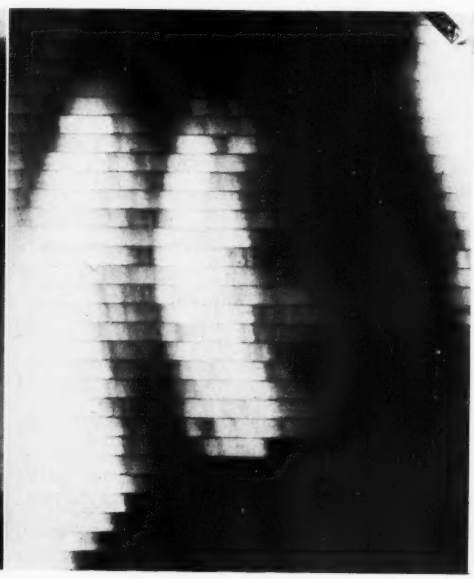


Fig. 26.

Fig 27.

Fig. 28.

down. He therefore went to a place of lower altitude (only 1,500 meters), but his condition grew worse. His stomach became upset, he started to vomit frequently, and for the past eight months he had stopped working. He also suffered from sciatica in his right leg. The right leg had been cooler for some time than the left leg.

Examination revealed his blood pressure to be 150/90 on both arms, the blood pressure at the legs measured 20 points higher on the right than on the left, but the oscillations were perfectly normal. The heart sounds were somewhat distant. The electrocardiogram showed perfectly normal tracings, except for low voltage of the R-waves and a flattened T in the routine extremity leads; but normal R-waves of the isolated left (CR_5) and right (CR_2) electrocardiograms of the chest leads. Here, too, the T-waves were flat. The urine and blood examinations showed no special abnormalities. The x-ray examination (Fig. 27) revealed that the tumor shadow growing out of the heart had increased enormously, filling up almost the entire left lung-field, pushing the heart somewhat to the right side. The lateral x-ray film (Fig. 28) also showed an increase of the shadow growing out of the heart, filling up the total retrosternal and retrocardiac space. The left diaphragm now stands much higher than the right. Examination before the fluoroscope showed scarcely any movement of the left diaphragm. No doubt the tumor is now producing a left-sided bronchial stenosis.

Examination of the gastro-intestinal tract revealed the liver pushing the contents of the abdomen to the left side, as a consequence of the low-standing right diaphragm, and, as a result of the high-standing left diaphragm, the stomach and part of the intestines are dislocated upward. There is no other pathological indication except two good-sized gallstones.

Referring to the literature and comparing our case with the descriptions of others, we believe that while in other cases the x-ray films could not be studied carefully, in our case the x-ray symptoms are so distinct we can hardly doubt the stated diagnosis. So it does not mean anything when we do not find the systolic murmur—which was found in other cases—if we do not find a marked pulsation, and other symptoms on the exterior of the thorax. We may explain these facts as favorable, showing that the aneurysm is highly organized, that it is filled with coagula, and, therefore, the blood content of the aneurysm changes very little, conforming to the action of the heart. On the other hand, the patient's youth—when the tumor was first detected—speaks against an aortic aneurysm and against a tumor, but for a pulmonary aneurysm.

But how can we explain the genesis of the aneurysm in our case? Arteriosclerosis may be excluded, not so much by the patient's age when the disease started, as by the clinical findings. Syphilis should have been excluded long ago according to the findings. If the serological findings were negative, they should, at least, have become positive after the first specific treatment. And the examination of the lumbar fluid was negative, too. Congenital syphilis also may be excluded, especially since the patient's liver was perfectly normal all the time.

I told the patient that he must have had an accident. Only then did he tell me that in his fourteenth year he had fallen from a wall two meters high, landing on his back so that he could not catch his breath for several minutes, but he did not feel any bad results. Ten years later he had an accident while horseback riding, fracturing a right rib.

I think we have the right to take the accident in the patient's fourteenth year, or both his accidents, as one of the causes for the later development of the aneurysm. But there is no reason why we should not, in this case, too, think that there was a second cause and this may have been a hypoplasia of the vessel walls, as described by B. S. Oppenheim. I think that we are justified for this assumption because the patient's aorta appears decidedly small for his age.

There is only one case of traumatic aneurysm of the pulmonary artery reported in the literature, namely, by Balaban and Pokidoff (12). But investigating the report, I must say that the films shown herein do not show anything except a somewhat prominent pulmonary arch of the heart shadow as we find it in asthenic patients or in harmless minor malformations of the heart. The clinical data and the patient's history, too, fail to prove the diagnosis in any way.

Therefore, I believe that our case is the first ever to be detected of a traumatic aneurysm of the stem of the pulmonary artery.

SUMMARY

The case history of a 45-year-old man is given. In his thirty-seventh year, a shadow was detected in the x-ray examination, about three centimeters in size, located in the area of the pulmonary artery. In spite of the fact that the patient had never had syphilis, that the Wassermann test and spinal fluid puncture were both negative, antisyphilitic treatment was instituted. The patient never showed any symptoms of arteriosclerosis, of any kind of infection, etc. Five years after the shadow was detected for the first time, the patient went to a medical institute, where a diagnosis of malignant tumor of the lungs was made. However, x-ray treatment was not successful. A chest operation was arranged for, but cancelled at the last moment because a very slight pulsation of the tumor was observed before the fluoroscope. At this time the tumor was from 8 to 10 cm. in size. By very careful x-ray examination in all diameters, the different diagnoses which could have been considered in such a case could be ruled out and, finally, the diagnosis of pulmonary aneurysm located at the stem of the pulmonary artery was settled upon. And again, by elimination, the conclusion was reached that this aneurysm must have been caused by an accident, perhaps on the basis of a hypoplastic wall. Only then did the patient reveal that he had had two severe accidents in his life, either of which was sufficient to have caused the aneurysm.

The patient was warned not to remain any longer at an altitude as high as 2,500 meters, but he disregarded this advice, and when he was seen three years later the aneurysm had grown enormously, filling out the entire left lung-field in the frontal x-ray film, and the entire retrosternal and most of the retrocardial space in the lateral view.

In the meantime, a stenosis of the left main bronchus with an immobilization of the left diaphragm had also taken place. Since during these eight years' observation, the heart never showed symptoms of decompensation, and since the tumor shadow in the x-ray film never showed a higher degree of pulsation, we can assume that this is a case of highly organized aneurysm.

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ROENTGEN DIAGNOSIS OF ABDOMINAL EFFUSIONS[1]

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From the X-ray Departments of the Kings County and Bushwick Hospitals

THE use of the x-ray continues to broaden as roentgenologists in their investigations attempt to apply the use of this means of diagnosis to more and varied conditions. The early use of roentgenology was limited to the bones, since the contrast was so marked that it produced a differentiation on the x-ray film regardless of the poor technical qualities and unsatisfactory equipment at hand at that time. No diagnosis was made in abdominal conditions because of the lack of differentiation of opacity of the various intra-abdominal structures. Consequently, the use of opaque mixture became necessary and barium was used for examination of the gastro-intestinal tract. The next advance was an attempt to diagnose obstruction of the alimentary tract by means of the contrasting gas against the more dense surrounding structures. The last procedure has been the attempt to diagnose collections of intra-abdominal fluid and it is the purpose of this presentation to offer an analysis of the diagnostic features utilized toward this end.

Technic.—The roentgenographic examination in itself is very simple; it need not tire the patient. It can be carried out without much loss of time while the operating room is being made ready, in the event that operation is found to be necessary. A view in supine position usually is sufficient. An upright dorso-ventral or a lateral view of the abdomen in supine position may be added. Sometimes a small amount of barium may be administered orally or a barium enema may be given if the condition of the patient permits. Since the demonstration of the abdominal walls is desirable, it may be attained by the interposition of a wedge of aluminum or paraffin equivalent to 3 mm. Al. If such a wedge is not obtainable, the light of a floor lamp from 60 to 100 watts will suffice to transilluminate the usually over-exposed area of the abdominal flanks during routine exposure.

Anatomy.—Unlike the chest which harbors two contrastingly different radiotranslucent groups of organs, *i.e.*, the respiratory (lungs) and circulatory (heart and vessels), this is not the case in the study of the abdomen. The variety of densities here encountered is similar, ranging from 1.018 to 1.050 specific gravity, thus taxing the attention of the roentgenologist to a great degree. With the advance of the technic, *i.e.*, the Bucky diaphragm, and high-powered tubes, permitting shorter and more satisfactory exposures, the domain of the abdominal examination has been given great importance. Although stress is laid upon the valuable information derived from the flat plate of the abdomen, such as an obstruction, the manifestations of the peritoneum have remained quite obscure.

The present report contains more than 200 cases of radiographically reported effusions, 80 of which were proved by paracentesis, laparotomy, or autopsy. The radiographic examinations represent diffusely uniform densities throughout the abdomen and obliteration of the organ outlines of the spleen, liver, and sometimes kidneys. The density is comparable to a uniform sheet which is contrasted only with the gas-bearing loops of the intestines. In spite of this uniform density of the abdomen, these gas-filled loops present no deformity in their shape or outline as should be expected in the presence of solid masses. These loops seem to float.

[1]This is one of a series of papers contributed by friends and former pupils of I. Seth Hirsch, M.D.

Fig. 1. (Group 1. Large effusions.) Patient, A. M., 59 years of age. Paracentesis done and 192 oz. fluid removed.

A survey of the literature led us to the extensive work of Laurel and an attempt will be made to classify our material in conformity with the additional signs indicating the presence of fluid as laid down by him.

The pelvic cavity, paracolic and subphrenic spaces, being the most dependent parts of the abdomen, offer the most favorable sites for effusion.

Small and Moderate Amounts of Effusion.—Small and moderate amounts of fluid form homogeneous strips of the same density as the muscles and blend with these and such organs as the liver and spleen. These strips are separated from the walls of the abdomen by the subperitoneal fat layers which soon also become edematous and attain the density of the muscles and organs. These strips of exudate present a smooth side outwardly and extend between the air-filled loops, forming biconcave protrusions not unlike the teeth of a comb. These strips may be formed by exudate as well as by fibrinous collections. Strips of exudate may also extend between the

Fig. 2.

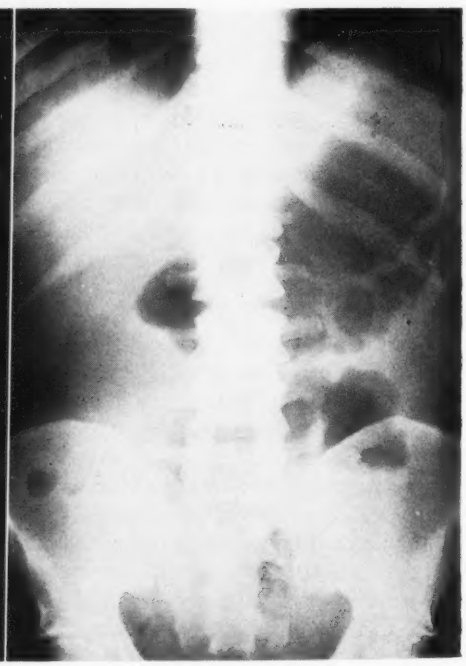

Fig. 3.

Fig. 2. (Group 1. Large effusions.) Patient, I. R., aged 48 years. Paracentesis revealed free fluid in abdominal cavity.

Fig. 3. (Group 1. Large effusions.) Patient, I. L. Exudate composed of serum and leukocytes and occasional plasma cells (600 c.c.).

Fig. 4. (Group 2. Moderate effusions.) Autopsy revealed a subphrenic abscess on the right side coming from a fistulous tract caused by pyonephrosis of the left kidney, subacute peritonitis, and displacement without distortion.

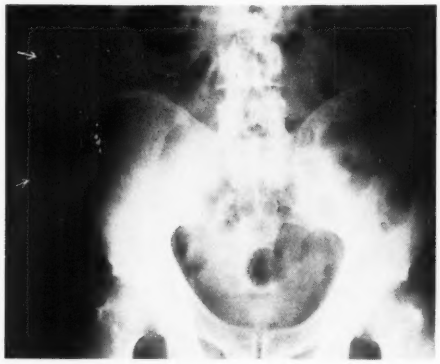

Fig. 5. (Group 2. Moderate effusions.) Postoperative findings revealed a retrocecal abscess, with foul-smelling pus, due to a ruptured appendix, and a large mass of intestines adherent to the parietal peritoneum.

haustra. Here, one must watch for plicæ epiploicæ or cross-section of haustra. Since similar strips are also formed by fibrinous deposits, the differentiation can be made only by change of the position during examination during which the fluid will change its shape. Adjoining walls of inflamed gut in peritonitis may resemble these manifestations and must not be confused.

Encysted Effusions.—Beside these appearances of exudate, one may encounter uniform round or angular densities which may be caused by fluid collections which, in turn, may be caused by fluid within a loop or by an omental mass or by an encysted empyema. The differentiation is difficult and may require additional views and examinations. Omental masses are frequently found in the left upper quadrant, at times displacing the stomach, or below the transverse colon. In the latter location they are not sufficiently dense to indicate fluid. Encysted effusions are fairly large homogeneous shadows in various parts of the abdomen in addition to those caused by the spleen and urinary bladder. But, here, one may also encounter empty or fluid-bearing small intestines giving homogeneous shadows closely resembling those of an exudate when they are surrounded by gas-filled small or large intestinal coils. These encysted collections may sometimes contain gas, be manifold, and intercommunicate. Thus, because they do not remain under pressure they cannot be palpated and, therefore, their evidence can be discovered only by x-ray examination. Fixed intestinal loops may become displaced by these fluid collections without any change in their shape. They may also be affected by the process and may present enlargement and irregular mucosal patterns and spasms after administration of a contrast enema. The subperitoneal fatty layers also suffer from the extension of the exudate by the edema and the engorgement of their vessels, assuming the density of the adjoining muscle. In this event, one must guard against amyloidosis, cachexia, senility, and infancy because the first three conditions cause disappearance of the fatty layers while in the last such layers are not yet developed.

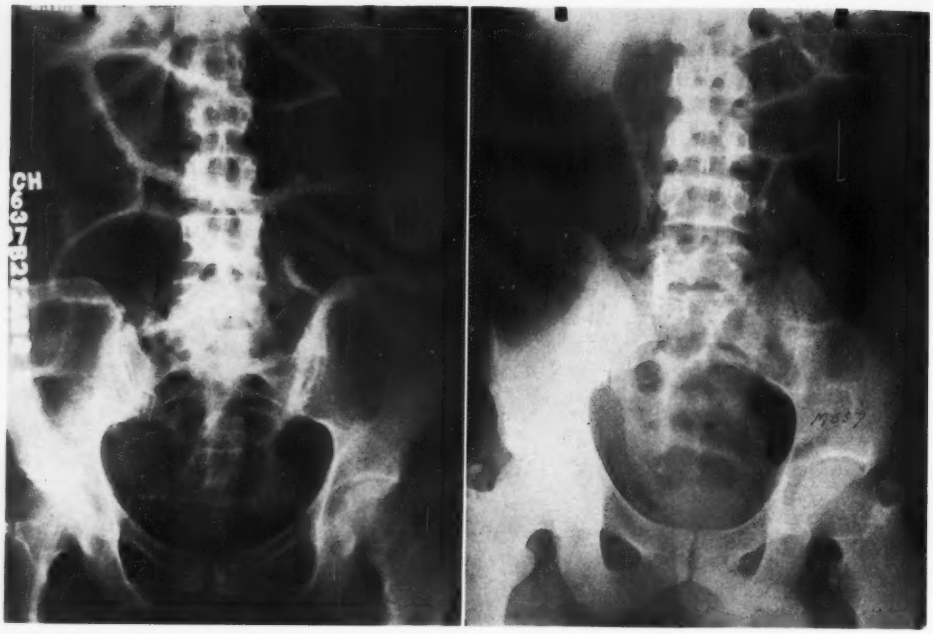

Fig. 6. Fig. 7.

Fig. 6. (Group 3. Minimal effusions.) Patient, J. N. Small intestinal obstruction ten days after appendectomy. Peritonitis and free pus.

Fig. 7. (Group 3. Minimal effusions.) Patient, E. B., 28 years of age. Operation revealed a large quantity of pus in the abdomen.

The iliopsoas spaces may obliterate when the inflammation has spread to the retroperitoneal tissues and a distinct reproduction of the vessels in the subcutaneous fatty layer takes place (Laurel). Respiration is difficult since the fluid presses against the diaphragmatic domes, flattening them out and elevating them upward and posteriorly. Thus, atelectasis may ensue and unilateral or bilateral pleural effusions take place.

CONCLUSIONS

Roentgen signs of abdominal effusions in which large and moderate amounts of fluid, including the encysted effusions, are found, are:

1. Uniformly increased density throughout the entire abdomen with obliteration of the borders of the abdominal organs such as the liver, spleen, and kidneys.

2. Elevation and flattening of one or both diaphragms with or without effusion on one or both sides and decreased or absent respiratory excursions.

3. The gas-bearing loops of the intestine do not show any change in shape despite increased density.

4. Obliteration of the subperitoneal and intramuscular fat layers.

5. Engorgement of the vessels with their distinct reproduction in the subcutaneous fatty layer (Laurel).

6. No change in the shape of the gut despite the displacement by the encapsulated fluid and the jagged appearance of the mucosal pattern in case of extension of the process. Fluid levels in case of gas abscesses.

7. Peritoneal irritation after the administration of barium manifested by the contraction of the gut, also encountered in other conditions such as pyelonephritis.

Roentgen signs of minimal abdominal effusions are:

1. Preservation of the shape of the intestines at the site of the effusion.
2. Obliteration of the subperitoneal fat layer.

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ACTIONS PERTAINING TO RADIOLOGY AT THE ST. LOUIS SESSION OF THE A.M.A.

Among the several official pronouncements pertaining to radiology which emanated from the annual meeting of the American Medical Association in St. Louis last June, the most important were those issued by the Reference Committee on Medical Education and subsequently adopted by the House of Delegates.

A revision of Section 7 of the "Essentials of a Registered Hospital," recommended by the Council on Medical Education and Hospitals, approved by the Reference Committee, and adopted by the House of Delegates, will have a far-reaching effect upon the practice of radiology in hospitals in the future. Though no drastic or sudden change in hospital-radiologist relationships is contemplated, new requirements embodied in the "Essentials" will undoubtedly lead to a gradual solution of some current controversies.

The revision is significant and definite. It followed a series of conferences between the Council and the Inter-Society Committee during the past year. A thorough discussion of the present tendency for hospitals to secure a profit from the professional practice of radiologists practising within its purlieu convinced the members of the Council that a clearer definition of the proper relationship between radiologists and hospitals was desirable. Accordingly, the Council agreed last February to recommend certain revisions in the "Essentials of a Registered Hospital."

Included in the complete report of the Council, which was adopted by the House of Delegates at the June meeting, was the following (Jour. Am. Med. Assn., **112**, 2166, 2167, May 27, 1939):

Essentials of a Registered Hospital

General Statement.—Hospitals should be organized and conducted primarily for the purpose of providing facilities where the sick and the injured of the community may be given scientific and ethical medical care.

Registration is a basic distinction between all recognized hospitals and those that are refused recognition. It is a prerequisite to the consideration of a hospital for approval for interns or for residencies in specialties.

The registration of hospitals, the approval of hospitals for interns, approval for residencies in specialties, and all other service of the Association regarding hospitals is carried on by the Council on Medical Education and Hospitals. Separate essentials have been adopted for each of these types of approval.

It is the desire of the Council to co-operate in every way for the improvement of hospital service, whereby the sick and injured may be provided with scientific and ethical medical care.

The Council does not have nor does it assume legal authority over any hospital. It recognizes clearly that the officers in charge of such institutions have the unquestioned right to conduct the hospitals in any way they may deem wise. If a hospital desires to have its name appear on the American Medical Association Hospital Register and thus have the endorsement of that Association, it should be willing to comply with the principles which the Council on Medical Education and Hospitals considers necessary.

. . . . . .

V. *Radiology.*—1. The responsibility for all radiologic examinations must rest on the physician-roentgenologist who is head of the department. His findings and conclusions for all examinations should be placed in the patient's chart. Nothing in this provision should preclude additional study and interpretations by qualified attending physicians on the staff.

2. The physician-roentgenologist should be preferably one who is a diplomate of the American Board of Radiology or a physician whose qualifications are acceptable to the Council on Medical Education and Hospitals of the American Medical Association.

3. It shall not be the policy of the hospital to make a profit from the department of radiology.

Equally important to the future of radiology was the action of the Council on Medical Education and Hospitals in approving the "Manual of Desirable Standards for Hospital Radiological Departments" which was submitted in tentative form by the Inter-Society Committee and a committee of the American College of Radiology. These two groups had previously collaborated in preparing a manual of "desirable standards" with the hope of securing the Council's approval. First discussed with the Council during the College Conference last February, the proposed Manual was revised to conform with suggestions offered at that meeting. The final draft was resubmitted in St. Louis, where the Council adopted a motion expressing its accord with the principles contained therein.

When final authority is received from the American College of Radiology the Manual

will be printed and distributed to all members of national radiological societies and will be available upon request to radiologists, hospital administrators, and others. Members of the College committee responsible for this important project are L. H. Garland, M.D., V. W. Archer, M.D., and R. A. Arens, M.D.

Only one resolution was introduced by the Section on Radiology and its purpose was to express the gratitude of the Section to the A. M. A. headquarters staff for support and assistance rendered to representatives of organized radiology. The resolution was adopted by the House of Delegates as follows (Jour. Am. Med. Assn., **112,** 2169):

Resolutions Expressing Appreciation of Staff at Headquarters

Dr. E. H. Skinner, Section on Radiology, presented the following resolutions, which were referred to the Reference Committee on Medical Education:

WHEREAS, The medical profession of America has been confronted with vital issues affecting the welfare of all citizens and the free integrity of medicine and calling for courageous leadership and positive action by the organized profession, and

WHEREAS, This action and leadership has been maintained through a loyal and competent headquarter's staff, and

WHEREAS, The Council on Medical Education and Hospitals, the Bureau of Medical Economics and other departments in the headquarters office have helped materially in the efforts of radiologists to maintain and raise the standards of radiologic practice, through which efforts definite progress in the gradual solution of some of our vexing problems has been achieved, thereby protecting medicine against insidious harm to one of its parts; therefore be it

RESOLVED, That the Section on Radiology expresses its appreciation and commendation of the members of the headquarters staff for their cordial assistance to the Inter-Society Committee for Radiology, as representative of all radiologists, and to this section in upholding and applying accepted principles to assure the continued advancement of radiologic practice and the protection of the science against adverse influences; and be it further

RESOLVED, That a copy of these resolutions be spread on the minutes of this session of the House of Delegates.

Particular attention was given by radiologists to a resolution introduced by the Illinois delegation which found fault with the action of the Judicial Council last year when it declared that the rental of radium should be regulated by certain restrictions. This action of the Judicial Council (Jour. Am. Med. Assn., **110,** 1489, April 30, 1938, Rental of Radium) was as follows:

"A widespread practice of renting radium for the treatment of patients by physicians not owning, or being experienced in the use of, radium has caused considerable discussion during the past year. Ordinarily instructions in the technic of the use of radium are sent by the person furnishing it. Sometimes the radium is furnished by a commercial concern, sometimes by a physician owning it. The advisability of the use of such a powerful agency by those not trained in its use and the ethics involved of prescribing and directing its use by a person who has not examined or seen the person on whom it is to be used, has come before the Council. As a result of a rather extensive correspondence, both from those favoring its use as described and those opposed, the Judicial Council is of the opinion that the prescribing and directing of its use in the case of a patient whom the prescriber has not examined or seen is an unethical medical procedure. The Council recognizes that advice and help in difficult cases is often furnished by those in a position to be of possible, or probable, assistance, but it believes that the great dangers accompanying the use of radium remove that particular remedy from the field of advice without personal contact with the patient."

The resolution was presented through the Illinois delegation and originated from the Adams County Medical Society of Illinois in which the city of Quincy is located. Its adoption was urged before the Reference Committee by several physicians from Illinois, Wisconsin, and Indiana. It was opposed by many physicians and radiologists from coast to coast and the action of the Judicial Council was defended by the Chairman, Dr. George E. Follansbee. The resolution was as follows (Jour. Am. Med. Assn., **112,** 2176):

Resolution on Prescribing of Radium

Dr. E. S. Hamilton, Illinois, presented the following resolution, which was referred to the Reference Committee on Amendments to the Constitution and By-laws and to the Judicial Council:

The report of the Special Committee appointed by the President of the Adams County Medical Society (Ill.) to study the present ruling of the American Medical Association relative to the rental of radium is as follows:

WHEREAS, At the San Francisco session last year the House of Delegates of the American Medical Association passed certain resolutions condemning the rental of radium under certain conditions, namely, the prescribing and directing of the use of radium in the case of a patient whom the prescriber has not examined or seen; and

WHEREAS, In consideration of the fact that such a rigid ruling would work a great hardship on thousands of members of the American Medical Association and cause great suffering to thousands of citizens of the United States, especially those who are remotely situated from sources of radium; that many patients would be denied the use of radium, if they were compelled to make long trips to a source of radium; that many patients have such great confidence in their physicians that they distinctly prefer that he personally administer such radium treatment; that since the pioneers in radium therapy and probably the greatest advocates of radium were not radiologists but leading gynecologists and dermatologists; that since many specialists are

well qualified to make many of the applications of radium, because of their specialized knowledge and surgical technic, as is the average radiologist; that since an experience of over twenty-five years, during which time many thousands of patients have been treated, has shown that many conditions in which radium is commonly used can be satisfactorily treated and with great benefit to the patient by the average physician under proper supervision and without a radiologist personally examining the patient on whom the radium is to be used; that because of the great expense of radium it is not practical for the average physician to own it; that the average physician sees so few cases in which radium is needed in his practice that it is not practical for him to make the large financial outlay to purchase it, and that since it is already considered an ethical procedure for physicians to lease radium for long periods or to own it outright, regardless of their qualifications to use it; therefore be it

RESOLVED, That it is considered ethical for a member of the American Medical Association personally to describe or write a description of a patient on whom he wishes to consider the use of radium and submit it to an experienced radiologist who likewise is a member of the American Medical Association; that if the condition is one in which radium is frequently used and if the radiologist believes the physician submitting the description can use radium with benefit to the patient, he may, therefore, prepare suitable radium applicators, recommend a technic of application and suggest dosage for the treatment of the case under consideration.

A motion to adopt this resolution with the recommendation that a copy be sent to the Secretary of the Illinois State Medical Society, and that the delegate of the Adams County Medical Society be instructed to present it to the House of Delegates of the Illinois State Medical Society at its next annual session (Rockford) for their approval and with the request that the delegates of the Illinois State Medical Society be requested to present it to the House of Delegates of the American Medical Association at its St. Louis meeting was adopted without dissenting vote. The Committee on Resolutions recommended the approval of the resolution presented by the Adams County Medical Society and the concurrence in its recommendations.

Adopted by House of Delegates May 4, 1939, Illinois State Medical Society.

The action of the Reference Committee was as follows (Jour. Am. Med. Assn., **112,** 2294):

Report of Reference Committee on Amendments to Constitution and By-laws

Dr. Charles E. Mongan, Chairman, presented the following report:

. . . . . .

Resolution on Prescribing of Radium: After careful consideration of the subject matter of the resolution and the action of the House of Delegates of the American Medical Association in 1938 at which the recommendation of the Judicial Council was approved, your reference committee believes that a careful reading of the report of the Judicial Council, which was to the effect that a physician prescribing for a patient without examining the said patient is performing an unethical act, will show that there was nothing expressed in the opinion of the Judicial Council regarding the owning or leasing of radium other than the relationship of the lessor to the user of the radium.

Your reference committee would invite the careful attention of each member of the House of Delegates to the exact wording of the resolution adopted by the House of Delegates in the 1938 session.

Your reference committee reiterates the language of the report of the Reference Committee on Amendments to the Constitution and By-Laws in 1938, which read as follows: "After due consideration of the matter, your committee feels that the phraseology should remain. Any exceptions to the general principle involved would defeat its purpose."

Your reference committee recommends, therefore, that the resolution presented by the Illinois State Medical Society be not adopted.

Respectfully submitted: Charles E. Mongan, *Chairman;* Edgar A. Hines, T. K. Gruber, Felix P. Miller, E. G. Wood.

The House of Delegates ratified this report.

There is an apparent failure on the part of many physicians to understand the simple implications of this action by the Judicial Council. In a previous issue of the *Bulletin* there is a complete exposition of the import and practical application of the resolution (RADIOLOGY, **31,** 234–236, August, 1938). Briefly, it declares unethical the prescribing of radium by any physician who has not examined the case. It does not preclude the rental of a definite amount of radium in a particular applicator which has been ordered by the physician who has examined the given case and knows what he wants.

An interesting resolution was introduced by the Section upon Pathology which indicates that other than radiologists are concerned now with the relationship of hospitals and physicians. Possibly the pathologists have taken some courage from the successful issue of the seven-year progression of radiologic ambitions. It is apparent that other than the specialties so intimately identified with hospital practice are now aware of the implications when hospital administration attempts to provide medical services by contract. The resolution of the pathologists was as follows:

Resolution Limiting Directorship of Approved Clinical Laboratory to Licensed Physician

Dr. Frederic E. Sondern, New York, presented the following resolution, which was referred to the Reference Committee on Medical Education:

WHEREAS, Years ago the examinations made by clinical laboratories were largely factual in nature and, as a consequence, a portion of the work was done by chemists and technicians not having medical degrees or being licensed to practice medicine;

WHEREAS, Particularly in the last one or two decades, the developments in laboratory medicine have been such as to require clinical medical knowledge for

the safe performance of many of the newer diagnostic procedures undertaken; and

WHEREAS, Specimens are obtained by surgical means from the spinal canal, veins, and organs of the body, and drugs and dyes are injected for the purpose of various functional tests, all definitely requiring clinical medical experience and judgment for their performance and interpretation if the safety of the patient is to be guarded; therefore be it

RESOLVED, That only a licensed physician duly qualified as a clinical pathologist may serve as the director of an approved clinical laboratory, as such practice is a specialty of medicine.

The action upon this by the Reference Committee which was sustained by a vote of the House of Delegates, was as follows:

Report of Reference Committee on Medical Education

Dr. Harvey B. Stone, *Chairman*, presented the following resolution as a substitute for the Resolution Limiting Directorship of Approved Clinical Laboratory to Licensed Physician, which was adopted on motion of Dr. Stone, duly seconded and carried:

WHEREAS, Years ago the examinations made by clinical laboratories were largely factual in nature and, as a consequence, a portion of the work was done by chemists and technicians not having medical degrees or being licensed to practise medicine; and

WHEREAS, The developments in laboratory medicine, particularly in the last one or two decades, have been such as to require clinical medical knowledge for the safe performance of many of the newer diagnostic procedures undertaken; and

WHEREAS, Specimens are obtained by surgical means from the spinal canal, veins, and organs of the body, and dyes and other drugs are injected for the purpose of various functional tests, all definitely requiring clinical medical experience and judgment for their performance and interpretation if the safety of the patient is to be guarded; therefore, be it

RESOLVED, That the American Medical Association specifically recognizes the practice of clinical pathology as a specialty of medicine and believes that those persons who practise it and who act as directors of clinical laboratories must be graduates of recognized medical schools and licensed to practise medicine in their respective States; and further be it

RESOLVED, That owing to the nature of the subject, the American Medical Association recognizes that it is necessary for these persons to complete at least three years of adequate training in clinical pathology, in addition to the training which they have received in regular courses in medical schools, before assuming the directorship of clinical laboratories.

E. H. SKINNER, M.D.

RADIOLOGICAL SOCIETIES IN THE UNITED STATES

Editor's Note.—Will secretaries of societies please cooperate with the Editor by supplying him with information for this section? Please send such information to Leon J. Menville, M.D., 1201 Maison Blanche Bldg., New Orleans, La.

CALIFORNIA

California Medical Association, Section on Radiology.—Chairman, Karl M. Bonoff, M.D., 1930 Wilshire Blvd., Los Angeles; *Secretary,* Carl D. Benninghoven, M.D., 95 S. El Camino Real, San Mateo.

Los Angeles County Medical Association, Radiological Section.—President, E. N. Liljedahl, M.D., 1322 North Vermont Ave., Los Angeles; *Vice-president,* M. L. Pindell, M.D., 678 South Ferris Ave.; *Secretary,* Wilbur Bailey, M.D., 2007 Wilshire Blvd.; *Treasurer,* Henry Snure, M.D., 1414 South Hope Street. Meets every second Wednesday of each month at County Society Building.

Pacific Roentgen Club.—Chairman, Karl M. Bonoff, M.D., Los Angeles; *Members of Executive Committee,* I. S. Ingber, M.D., A. C. Siefert, M.D., D. R. MacColl, M.D.; *Secretary-Treasurer,* L. Henry Garland, M.D., 450 Sutter St., San Francisco. Executive Committee meets quarterly; Club meets annually during annual session of the California Medical Association.

San Francisco Radiological Society.—Secretary, L. H. Garland, M.D., 450 Sutter Street. Meets monthly on first Monday at 7:45 P.M., alternately at Toland Hall and Lane Hall.

COLORADO

Denver Radiological Club.—President, F. B. Stephenson, M.D., 452 Metropolitan Bldg.; *Vice-president,* K. D. A. Allen, M.D., 452 Metropolitan Bldg.; *Secretary,* E. A. Schmidt, M.D., 4200 E. Ninth Ave.; *Treasurer,* H. P. Brandenburg, M.D., 155 Metropolitan Bldg. Meets third Tuesday of each month at homes of members.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Chairman, Samuel M. Atkins, M.D., 63 Central Ave., Waterbury; *Secretary-Treasurer,* Max Climan, M.D., 242 Trumbull St., Hartford. Meetings twice annually in May and September.

DELAWARE

Affiliated with Philadelphia Roentgen Ray Society.

FLORIDA

Florida Radiological Society.—President, H. B. McEuen, M.D., Jacksonville; *Vice-president,* Joseph H. Lucinian, M.D., Miami; *Secretary-Treasurer,* John N. Moore, M.D., 210 Professional Bldg., Ocala. Meetings held in November and at the annual meeting of the Medical Association of Florida in the spring.

GEORGIA

Georgia Radiological Society.—President, James J. Clark, M.D., Doctors Bldg., Atlanta; *Vice-president,* L. P. Holmes, M.D., University Hospital, Augusta; *Secretary-Treasurer,* Robert C. Pendergrass, M.D., Prather Clinic, Americus. Meetings twice annually, in November and at the annual meeting of the Medical Association of Georgia in the spring.

ILLINOIS

Chicago Roentgen Society.—President, Roe J. Maier, M.D.; *Vice-president,* Adolph Hartung, M.D.; *Secretary,* Chester J. Challenger, M.D., 3117 Logan Blvd. Meetings the second Thursday of each month from October to May, except December, at the Hotel Sherman.

Illinois Radiological Society.—President, Cesare Gianturco, M.D., 602 W. University Ave., Urbana; *Vice-president,* Fred H. Decker, M.D., 802 Peoria Life Bldg., Peoria; *Secretary-Treasurer,* Edmund P. Halley, M.D., 968 Citizens Bldg., Decatur. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—The next meeting will be in Peoria, in May, 1940. The officers are: *Chairman,* Warren W. Furey, M.D., 6844 Oglesby Ave., Chicago; *Secretary,* Harry W. Ackemann, M.D., 321 W. State St., Rockford.

INDIANA

The Indiana Roentgen Society.—President, Juan Rodriguez, M.D., 2902 Fairfield Ave., Fort Wayne; *President-elect,* H. H. Inlow, M.D., Shelbyville; *Vice-president,* Wemple Dodds, M.D., Crawfordsville; *Secretary-Treasurer,* Clifford C. Taylor, M.D., 23 E. Ohio St., Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—President, D. B. Harding, M.D., Lexington; *Vice-president,* I. T. Fugate, M.D., Louisville; *Secretary-Treasurer,* Joseph C. Bell, M.D., 402 Heyburn Bldg., Louisville. Meeting annually in Louisville, third Sunday afternoon in April.

MAINE

See New England Roentgen Ray Society.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Chairman, Whitmer B. Firor, M.D., 1100 N. Charles St.; *Secretary,* Walter L. Kilby, M.D., 101 W. Read St. Meetings third Tuesday of each month.

MASSACHUSETTS

See New England Roentgen Ray Society.

MICHIGAN

Detroit X-ray and Radium Society.—President, Sam W. Donaldson, M.D., 326 N. Ingalls St., Ann Arbor;

Vice-president, Clarence Hufford, M.D., 421 Michigan Ave., Toledo, Ohio; *Secretary-Treasurer*, E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave.

Michigan Association of Roentgenologists.—President, C. K. Hasley, M.D., 1429 David Whitney Bldg., Detroit; *Vice-president*, M. R. Cooley, M.D., Mercy Hospital, Jackson; *Secretary-Treasurer*, C. S. Davenport, M.D., 609 Carey St., Lansing. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—President, Leo G. Rigler, M.D., University Hospital, Minneapolis; *Vice-president*, Harry M. Weber, M.D., Mayo Clinic, Rochester; *Secretary*, John P. Medelman, M.D., 572 Lowry Medical Arts Bldg., St. Paul. These officers will assume their duties after the Summer meeting which will be held in connection with the Minnesota State Medical Society, May 31 to June 2, 1939.

MISSOURI

The Kansas City Radiological Society.—President, L. G. Allen, M.D., 907 N. 7th St., Kansas City, Kansas; *Secretary*, Ira H. Lockwood, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—President, Paul C. Schnoebelen, M.D.; *Secretary*, W. K. Mueller, M.D., University Club Bldg. Meets on fourth Wednesday of October, January, March, and May, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—President, T. T. Harris, M.D., Clarkson Memorial Hospital, Omaha; *Secretary*, D. Arnold Dowell, M.D., 117 S. 17th St., Omaha. Meetings first Wednesday of each month at 6 P.M. in Omaha or Lincoln.

NEW ENGLAND ROENTGEN RAY SOCIETY

(Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island.) *President*, Langdon T. Thaxter, M.D., Maine General Hospital, Portland, Maine; *Secretary*, Aubrey O. Hampton, M.D., Massachusetts General Hospital, Boston. Meetings third Friday of each month from October to May, inclusive, usually at Boston Medical Library.

NEW HAMPSHIRE

See New England Roentgen Ray Society.

NEW JERSEY

Radiological Society of New Jersey.—President, P. S. Avery, M.D., Middlesex Hospital, New Brunswick; *Vice-president*, J. G. Boyes, M.D., 912 Prospect Ave., Plainfield; *Treasurer*, H. A. Vogel, M.D., 1060 E. Jersey St., Elizabeth; *Secretary*, W. James Marquis, M.D., 198 Clinton Ave., Newark; *Counsellor*, A. W. Pigott, M.D., Skillman. Meetings at Atlantic City at time of State Medical Society, and Midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—President, Henry A. Barrett, M.D., 140 East 54th St., New York City; *President-elect*, I. J. Landsman, M.D., 910 Grand Concourse, New York City; *Vice-president*, Frederic E. Elliott, M.D., 122 76th St., Brooklyn; *Treasurer*, Solomon Fineman, M.D., 133 East 58th St., New York City; *Secretary*, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—President, Albert Voltz, M.D., 115–120 Myrtle Avenue, Richmond Hill; *Vice-president*, A. L. L. Bell, M.D., Long Island College Hospital, Henry, Pacific, and Amity Sts., Brooklyn; *Secretary-Treasurer*, E. Mendelson, M.D., 132 Parkside Ave., Brooklyn. Meetings first Tuesday in each month at place designated by president.

Buffalo Radiological Society.—President, Chester D. Moses, M.D., 333 Linwood Ave.; *Vice-president*, Edward C. Koenig, M.D., 100 High St.; *Secretary-Treasurer*, Joseph S. Gian-Franceschi, M.D., 610 Niagara St. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen-ray Society.—President, J. R. Pawling, M.D., 205 Trust Co. Bldg., Watertown; *Vice-president*, A. Lenz, M.D., 613 State St., Schenectady; *Secretary-Treasurer*, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings held in January, May, and October as called by Executive Committee.

Long Island Radiological Society.—President, Samuel G. Schenck, M.D., Brooklyn; *Vice-president*, G. Henry Koiransky, M.D., Long Island City; *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn; *Treasurer*, Louis Goldfarb, M.D., 608 Ocean Ave., Brooklyn. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—President, Harry M. Imboden, M.D., 30 W. 59th St., New York City; *Vice-president*, Henry K. Taylor, M.D., 667 Madison Ave., New York City; *Secretary*, Roy D. Duckworth, M.D., 170 Maple Ave., White Plains, N. Y.; *Treasurer*, Eric J. Ryan, M.D., St. Luke's Hospital, New York City.

Rochester Roentgen-ray Society.—Chairman, Joseph H. Green, M.D., 277 Alexander St.; *Secretary*, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—President, Robert P. Noble, M.D., 127 W. Hargett St., Raleigh; *Vice-president*, A. L. Daughtridge, M.D., 144 Coast

Line St., Rocky Mount; *Secretary-Treasurer*, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meetings with State meeting in May, and meeting in October.

OHIO

Cleveland Radiological Society.—*President*, J. H. West, M.D., 10515 Carnegie Ave.; *Vice-president*, Harry Hauser, M.D., City Hospital; *Secretary-Treasurer*, H. A. Mahrer, M.D., 10515 Carnegie Ave. Meetings at 6:30 P.M. at the Mid-day Club, in the Union Commerce Bldg., on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*President*, B. M. Warne, M.D., Doctors Building, Cincinnati; *Secretary-Treasurer*, Justin E. McCarthy, M.D., 707 Race St., Cincinnati, Ohio. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—*President*, Charles S. Caldwell, M.D., 520 S. Aiken Ave., Pittsburgh; *First Vice-president*, Thomas L. Smyth, M.D., 111 N. 8th St., Allentown; *Second Vice-president*, Reuben G. Alley, M.D., Western Pennsylvania Hospital, Pittsburgh; *Secretary-Treasurer*, Lloyd E. Wurster, M.D., 416 Pine St., Williamsport; *President-elect*, Louis A. Milkman, M.D., 212 Medical Arts Bldg., Scranton; *Editor*, William E. Reiley, M.D., Clearfield.

The Philadelphia Roentgen Ray Society.—*President*, H. Tuttle Stull, M.D., 3260 N. Broad St., Philadelphia, Penna.; *Vice-president*, Joseph E. Roberts, Jr., M.D., 403 Cooper St., Camden, N. J.; *Secretary*, Barton R. Young, M.D., Temple University Hospital, Philadelphia, Penna.; *Treasurer*, Fay K. Alexander, M.D., Chestnut Hill Hospital, Philadelphia, Penna.

The Pittsburgh Roentgen Society.—*President*, Zoe A. Johnston, M.D., 601 Jenkins Arcade; *Vice-president*, Prentiss A. Brown, M.D., and *Secretary-Treasurer*, Harold W. Jacox, M.D., 4800 Friendship Ave. Meetings held second Wednesday of each month at 4:30 P.M., from October to June at various hospitals designated by program committee.

RHODE ISLAND

See New England Roentgen Ray Society.

SOUTH CAROLINA

South Carolina X-ray Society.—*President*, Percy D. Hay, Jr., M.D., McLeod Infirmary, Florence; *Secretary-Treasurer*, Hillyer Rudisill, Jr., M.D., Roper Hospital, Charleston. Meetings in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

SOUTH DAKOTA

Meets with Minnesota Radiological Society.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—*President*, Steve W. Coley, M.D., Methodist Hospital, Memphis; *Vice-president*, Eugene Abercrombie, M.D., 305 Medical Arts Bldg., Knoxville; *Secretary-Treasurer*, Franklin B. Bogart, M.D., 311 Medical Bldg., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—*President*, Jerome H. Smith, M.D., San Antonio; *President-elect*, C. F. Crain, M.D., Corpus Christi; *First Vice-president*, M. H. Glover, M.D., Wichita Falls; *Second Vice-president*, G. D. Carlson, M.D., Dallas; *Secretary-Treasurer*, Henry C. Harrell, M.D., 517 Pine St., Texarkana. Meets annually. Temple is place of next meeting.

VERMONT

See New England Roentgen Ray Society.

VIRGINIA

Radiological Society of Virginia.—*President*, Fred M. Hodges, M.D., 100 W. Franklin St., Richmond; *Vice-president*, L. F. Magruder, M.D., Raleigh and College Aves., Norfolk; *Secretary*, V. W. Archer, M.D., University of Virginia Hospital, Charlottesville.

WASHINGTON

Washington State Radiological Society.—*President*, H. E. Nichols, M.D., Stimson Bldg., Seattle; *Secretary*, T. T. Dawson, M.D., Fourth and Pike Bldg., Seattle. Meetings fourth Monday of each month at College Club.

WISCONSIN

Milwaukee Roentgen Ray Society.—*President*, H. W. Hefke, M.D.; *Vice-president*, Frederick C. Christensen, M.D.; *Secretary-Treasurer*, Irving I. Cowan, M.D., Mount Sinai Hospital, Milwaukee. Meets monthly on first Friday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—*Secretary*, Russel F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—*Secretary*, E. A. Pohle, M.D., 1300 University Ave., Madison, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

EDITORIAL

LEON J. MENVILLE, M.D., *Editor* HOWARD P. DOUB, M.D., *Associate Editor*

COSTS AND FEES

A fruitful topic of conversation among medical men who are inclined to be critical is the high cost of radiological work, especially that done in connection with diagnosis. That it is frequently an expensive procedure for persons of moderate or less than moderate means must be admitted. Those of us who do the work and pay the operative and other costs will also agree that it is expensive to do. All of us who are interested in radiological diagnosis are constantly faced with the problem of attempting to bring the cost to the patient down to his financial ability.

It is probably true that, in most parts of the country, the average fees collected for radiological diagnosis are lower than they used to be. On the other hand, however, the ability to lower fees and extend the benefits of radiological diagnosis to greater numbers of persons has been definitely limited by increasing costs to the radiologist. For the most part, labor costs are no less, probably salaries are a little better than they used to be, certainly the salaries of first-class technicians are. Films and related supplies have not gone down in price appreciably in twenty years. Apparatus is no cheaper; on the contrary, both it and tubes are certainly more expensive. It must be admitted, however, that they are both immeasurably superior to the old tubes and apparatus. They have generally longer life and certainly are much more efficient, but the increased cost counterbalances the above advantage to some extent at least.

The greatest increase in cost is probably the result of the more elaborate and time-consuming procedures that have become standard and necessary, and while new procedures have opened up many new fields for radiological diagnosis, the majority of these are costly. Among these is the radiological diagnosis of cerebral and genito-urinary lesions. The ordinary fee that is available from the patient who has a thorough study by means of ventriculograms or encephalograms or who has an intravenous or retrograde pyelography is frequently hardly more than adequate to pay the actual technical and operating expense. Erect pyelograms, which have come into general use along with the supine procedures, mean added time and added expense, as well as new and more expensive equipment. The use of shock-proof equipment, which is generally recognized now as standard and with which we are all replacing our old exposed tubes and overhead systems, has raised costs appreciably. This does not mean that they are not more desirable and probably worth what they cost, but it does add a definite difficulty to the problem of furnishing adequate work done with adequate equipment and help, for less money.

The best answer to the problem of fees adjustable downward is probably volume. From a practical standpoint, there are two difficulties here. One is the very definite competition of small private laboratories in the offices of internists, orthopedists, urologists, and others, in which the work is done by a part-time technician of questionable ability, who turns out work of questionable value both from a technical and a professional standpoint. The inroad on the qualified specialist's practice by this type of competition is no small matter. The unfortunate part of the situation is that in spite of all the efforts of qualified specialists to educate the general profession to distinguish between good and poor work, even only technical work, the ordinary doctor seems totally unable to make the distinction or to appreciate it.

With regard to the other difficulty, many of us wonder just how much procedures can be shortened and simplified and supervision spread out on a kind of mass production basis, and still

not fail to reach some definite necessary minimum standard of performance. In other words, of what does a necessary minimum diagnostic performance consist? We must not forget the principle that a diagnostic procedure is safe and reliable only when it is exhausted. Observation of the methods used in various presumably first-class laboratories throughout the country lead one quite definitely to the conclusion that there is very little agreement as to what is a standard necessary procedure. The methods and the standards thought acceptable, it would seem to the writer, are dictated frequently by economic factors and limitations rather than by definite professional standards, as they should be. One inquires as to whether a careful study of this problem by a qualified group of radiologists might not be of distinct value and benefit alike to the radiologist, the attending physician, and the patient.

RAYMOND G. TAYLOR, M.D.

ANNOUNCEMENTS

NEXT ANNUAL MEETING

The Committee on Publicity and Education wishes to remind the membership of the Radiological Society of North America of the Second Annual Refresher Post-graduate Series to be given in conjunction with the Annual Meeting in Atlanta, December 10–15 of this year.

As previously announced, the clinics, ordinarily a part of the Annual Meeting, will not be offered this year. In their place the Refresher Series will be given on Sunday afternoon and evening and from 8 A.M. to 10 A.M.. each day of the meeting. Several courses, including Radiology of the Chest, Radiology of the Gastro-intestinal Tract, Radiology of Bone Tumors, Radiation Physics, Radiology of Sinuses and Mastoids, Roentgen Analysis of Fractures, and a few others will be offered sequentially from Sunday through Friday. In addition, a larger series of related short subjects will also be offered.

There will be no charge for registration and members of the Society will be given preference.

The Committee urges that the members plan early to attend the entire series, so that the faculty of nationally known teachers will feel repaid for their effort in offering the courses.

THE AMERICAN BOARD OF RADIOLOGY

The next examination of the American Board of Radiology will be held in Atlanta, Georgia, December 9, 10, and 11, 1939. Those wishing to receive appointments for this examination should have their applications in the office of the Secretary not later than September 1. There will also be an examination in New York City in June, 1940, just preceding the meeting of the American Medical Association.

There will *not* be an examination in Chicago at the time of the meeting of the American Roentgen Ray Society.

B. R. KIRKLIN, M.D., *Secretary*

COMMUNICATIONS

RADIOLOGY AND THE GENERAL PUBLIC

A Brief Description of the Pacific Roentgen Club's Educational Exhibit at the San Francisco Golden Gate International Exposition

The California World's Fair, or Golden Gate International Exposition, was created to commemorate the completion of the two bridges spanning San Francisco Bay, two remarkable feats in modern bridge engineering. The main portion of the Fair consists of twelve large buildings set amongst extensive gardens and lakes. One of the first of these buildings is the Hall of Science, with a floor space of approximately 50,000 square feet. The exhibits therein are devoted to "Research in Human Progress," over one-half being related to medical science. The following American scientific societies have exhibits: The American Medical Association, the California Medical Association, the American and California Associations for the Advancement of Science, the American Dental Association, the California Tuberculosis and Heart Associations, the American National Red Cross, the California State Department of Health, the Mayo Clinic, the Pacific Roentgen Club, and others. In most of these exhibits, roentgenograms form significant parts of the display.

It was only shortly before the Fair opened that the Pacific Roentgen Club was invited to create an exhibit for a large booth which was still unoccupied (1,500 square feet). A special

committee of the Club, under the Chairmanship of Harold A. Hill, M.D., went to work immediately and in less than two weeks created an exhibit which, to our surprise, has been one of the most popular in the Hall of Science. The exhibit is entitled "Magic Shadows: The Story of X-ray." It shows, by the use of approximately seventy roentgenograms, diagrams, and photographs, the nature and usefulness of x-rays in modern medical diagnosis and treatment.

Fig. 1. The Pacific Roentgen Club Exhibit at the California World's Fair. Portion of the front of the exhibit booth. (*Note:* This and the following photographs were made at "closing time" at which hour the public has largely vacated the pavilions.)

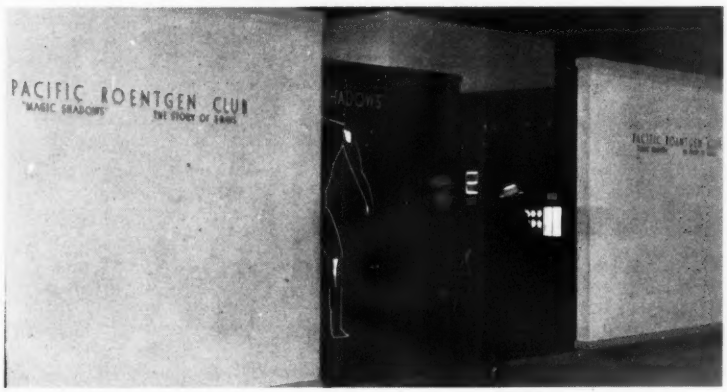

Fig. 2. View of the front portion of the exhibit.

There are five main panels. In the first panel, a comparison is made between radiography and photography, with clear explanations of both. In the second section, illustrations are provided showing the uses of x-rays in diagnosis and treatment of tumors, and in the fifth, a brief exhibit of the uses of x-rays in industry itself. Although the exhibit is silent and without regular attendants, it has proved to be one of the main attractions in the Hall of Science.

No equipment is exhibited, chiefly because it is desired to emphasize the fact that medical training in radiology is more important than equipment in the medical application of x-rays. The attendance and interest, as above stated, have been far greater than anticipated, and it

is believed that considerable public education will be the result.

The Local Committee responsible for the exhibit, to whom great credit is due, is composed of: Harold A. Hill, M.D., Frederick H. Rodenbaugh, M.D., Charles Capp, M.D., Maurice Robinson, M.D., Robert R. Newell, M.D., Edward Leef, M.D., Arthur Williams, M.D., and Charles Fulmer, M.D. The following physicians, technicians, and volunteers also

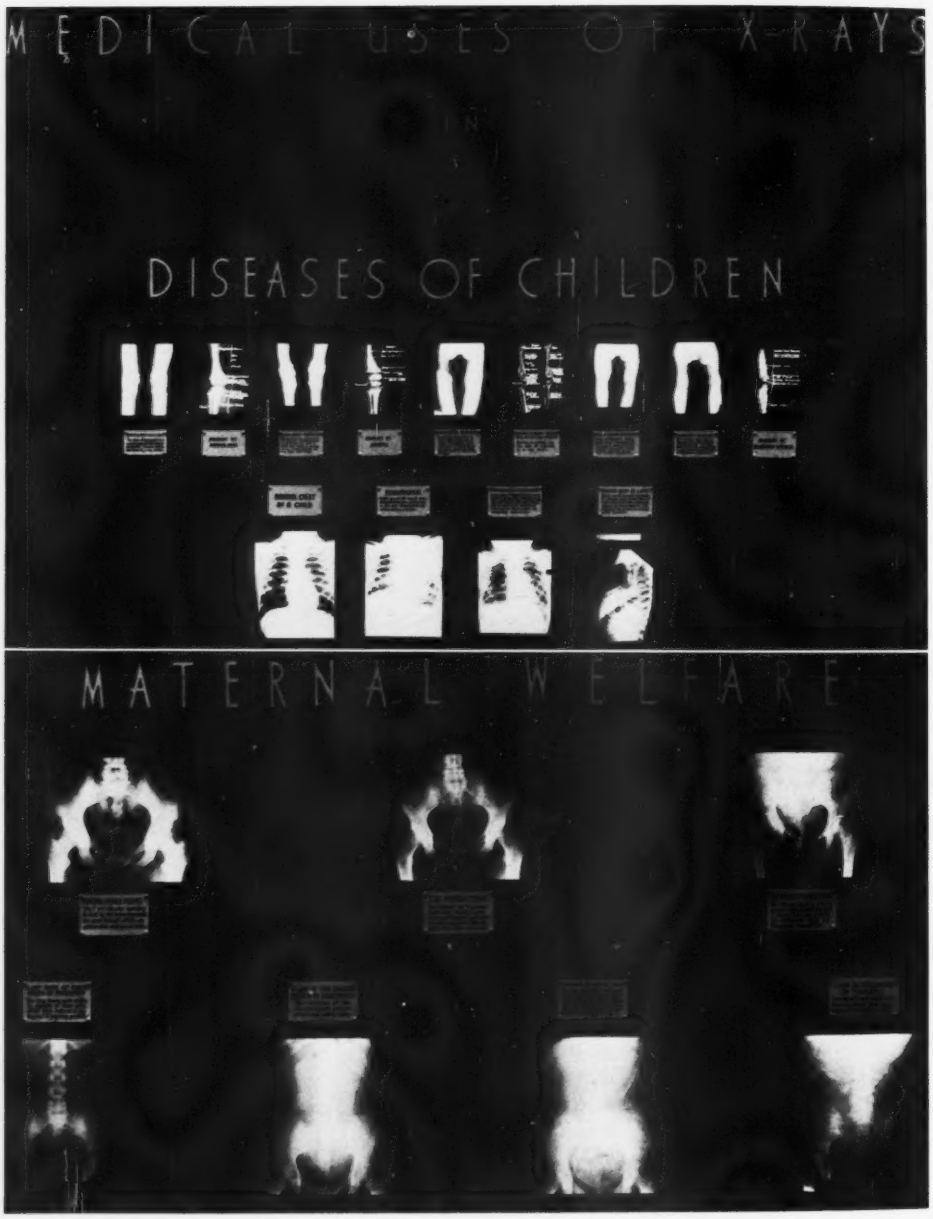

Fig. 3 (*above*). Portion of the panel showing uses of x-rays in diseases of children.
Fig. 4 (*below*). Portion of the panel showing uses of x-rays in maternal welfare.

rendered invaluable assistance in the installation of the exhibit: A. Petrilli, M.D., Edith Miller, M.D., Maurice Sachs, M.D., and Marjorie Mottram, M.D.; Messrs. E. N. Dudman and C. Wiethaup, Mrs. Dudman, and Miss Comfort. This Committee received great help from Dr. Milton Silverman, the Director of the Hall of Science, without whose advice and cooperation the exhibit could never have been completed.

L. H. GARLAND, M.D.

SPECIAL POST-GRADUATE COURSES FOR RADIOLOGISTS

The University of Minnesota is offering a series of special three-day post-graduate courses for radiologists. They will be given at the Center for Continuation Study, the exclusive residence and classroom building for post-graduate students on the main campus, Minneapolis. The special series for radiologists is part of the general post-graduate program. Since Jan. 1, 1937, more than 1,200 registrants have attended the 38 medical and hospital post-graduate courses which have been given by the Department of Post-graduate Medical Education under the direction of William A. O'Brien, M.D. For the past year, the program has been assisted by a special grant from the Commonwealth Fund, New York. With this new development the University of Minnesota now has three divisions in the Medical School—undergraduate, graduate, and post-graduate.

The first course in the special series for radiologists was in Radiation Physics on June 12, 13, and 14, 1939. The program was arranged and directed by K. W. Stenstrom, Ph.D., Professor of Biophysics and Director of the Division of Radiation Therapy, University of Minnesota. In addition to Dr. Stenstrom, the faculty included Lauriston S. Taylor, Physicist, National Bureau of Standards, United States Department of Commerce, Washington, D. C.; Ernst A. Pohle, M.D., Ph.D., Professor of Radiology, University of Wisconsin; Otto Glasser, Ph.D., Biophysicist, Cleveland Clinic; Arthur U. Desjardins, M.D., Professor of Radiology, Mayo Foundation; Marvin M. D. Williams, Ph.D., Instructor in Biophysics, Mayo Foundation; J. William Buchta, Ph.D., Professor and Chairman of Physics Department; Leo G. Rigler, M.D., Professor and Head of Radiology; Edward Schons, M.D., Special Lecturer, General Extension Division; John T. Tate, Ph.D., Professor of Physics; Joseph Valasek, Ph.D., Associate Professor of Physics; Irwin Vigness, Ph.D., Instructor in Biophysics; John H. Williams, Ph.D., Associate Professor of Physics—all of the University of Minnesota.

The subjects were presented in the form of lectures, demonstrations, and question-and-answer periods. They included History of Roentgen, Atomic Structure, Artificial Radioactivity, Radiologic Diagnosis, Quality and Quantity of Roentgen Rays, Diffraction, Refraction, Reflection and Spectroscopy, Absorption of Roentgen Rays, Van de Graaff Apparatus, Biological Factors, Radiation Biology, Radiologic Protection, Dosage Measurements, Radiologic Therapy, and Demonstration of 1,200-kilovolt Treatment Apparatus.

The next course in the special series for radiologists will deal with Roentgenologic Diagnosis of Diseases of the Nervous System. The date will be announced in the near future. It will occupy the full time of those in attendance from 8:30 A.M. to 8:30 P.M. on each of the three days. A concentrated schedule is made possible by holding the course in the same building in which the physicians will live. The entire building will be reserved for the group. The tuition for each three-day special radiologic course will be $15.00. An average single room and all meals is $8.25 for the three days. Use of the garage is $0.50 a day, and there are no other extras. The faculty will include members of the faculty of the undergraduate and graduate schools, Mayo Foundation, and distinguished radiologists from other medical centers. Enrollment in each course will be limited to the number who can best profit by the instruction. Only radiologists will be admitted.

Further information may be obtained from William A. O'Brien, M.D., Director, Department of Post-graduate Medical Education, University of Minnesota, Minneapolis, Minnesota.

ADVISORY COUNCIL ON MEDICAL EDUCATION

The Advisory Council on Medical Education was created to-day [June 24, 1939] at a meeting in Chicago by eleven national organizations concerned with the training of physi-

cians to meet the present-day needs of medical care for the country. The need for some central representative agency has long been recognized, to make medical training more effective than it has been in its service to the public.

Willard C. Rappleye, M.D., Dean of the Faculty of Medicine of Columbia University, who was elected president, stated that the purpose of the Advisory Council is to correlate the efforts of the universities, medical schools, hospitals, licensing bodies, public health associations, and boards of specialists.

"This organization brings together for the first time the various national bodies dealing with all phases of the training and licensing of physicians beginning with his preparatory college work and including medical education, hospital internship, residency, licensure, and graduate training for specialization. Co-operation and co-ordination are to be substituted for present overlapping and competing functions of existing agencies."

The organizations represented on the Advisory Council on Medical Education are: Association of American Medical Colleges; American Hospital Association; Catholic Hospital Association; Federation of State Medical Boards of the U. S. A., Advisory Board for Medical Specialties; National Board of Medical Examiners; American College of Physicians; American College of Surgeons; Association of American Universities; American Association for the Advancement of Science, Division of Medical Sciences; American Public Health Association.

Two new organizations were elected to membership to-day: American Protestant Hospital Association and the Association of American Colleges.

Among the important problems considered by the Advisory Council at its meeting were those of proper educational standards of the hospital internship, adequate training for the specialist, sound programs for the continued education of physicians in practice, modifications in college preparation for medical studies, the simplification of the procedure for licensure in the 48 separate states, and the status of training of graduates of foreign medical schools. Special committees of the Council were appointed to study these various questions.

The Officers are as follows: Willard C. Rappleye, M.D., Dean of the Faculty of Medicine of Columbia University, *President;* Maurice H. Rees, M.D., Dean of the School of Medicine of the University of Colorado, *Vice-president;* Robin C. Buerki, M.D., Director of Study of the Commission on Graduate Medical Education, *Secretary-Treasurer.*

The Executive Committee consists of the officers and the following: Anton J. Carlson, M.D., Professor of Physiology of the University of Chicago; Harold Rypins, M.D., Secretary of the New York State Board of Medical Examiners; Hugh J. Morgan, M.D., Professor of Medicine of Vanderbilt University; Arthur W. Allen, M.D., Surgeon, Boston.

The organizations represented on the Advisory Council are: Association of American Medical Colleges, 3 representatives; American Hospital Association, 3; Catholic Hospital Association, 1; Federation of State Medical Boards of the United States of America, 3; Advisory Board for Medical Specialties, 3; National Board of Medical Examiners, 1; American College of Surgeons, 2; American College of Physicians, 2; Association of American Universities, 2; American Public Health Association, 1; American Association for the Advancement of Science, Division of Medical Sciences, 1.

The new members will have the following membership: American Protestant Hospital Association, 1; Association of American Colleges, 2.

ROBIN C. BUERKI, M.D.

CHRISTIE HOSPITAL AND HOLT RADIUM INSTITUTE, MANCHESTER, ENGLAND

TRAINING IN RADIOTHERAPY—CLINICAL ASSISTANTSHIPS

The above institution offers two Clinical Assistantships (unsalaried) to selected candidates desirous of obtaining experience in radium and x-ray therapy.

The appointees will be expected to remain for a period of not less than four months on a whole-time basis and must have had either previous surgical experience or hold a diploma in radiology.

Registration fee, £1. 1. 0 per month.

Certificates will be granted on completion of the course from the Faculty of Medicine of the Manchester University.

The appointments offer an unusually good opportunity of gaining experience in all branches of modern radiotherapy.

BOOK REVIEWS

ELEKTRODIAGNOSTIK (Electrodiagnosis). By DR. B. NEOUSSIKINE and DR. D. ABRAMOWITSCH, Tel Aviv. A volume of 242 pages, with 30 figures. Published by Hans Huber, Bern, Switzerland, 1939. Price: 12 francs or 7.20 R.M.

This textbook on electrodiagnosis, written in German and published in Switzerland, describes various methods of electrodiagnosis in detail and discusses their value.

The book has been divided into six major sections: the first surveys the physical properties of electrodiagnosis, the atomic theory, and fundamental electrical conceptions. It is difficult to discuss the atomic theory briefly and in a manner which is interesting and intelligible to readers. Those who have experience in this field will probably find that details have been omitted which might well have been mentioned. Those unfamiliar with the field may not gain a correct conception of the phenomena.

The chapter dealing with classical methods of electrodiagnosis repeats information available in the textbooks which are cited. Nearly two-thirds of the book are devoted to the so-called historical and classical method of electrodiagnosis which was introduced about eighty years ago by Duchenne and later developed by Dubois, Pfluger, and Erb. Less space is devoted to a review of more modern methods of electrodiagnosis, especially of Chronaxie. Somewhat enthusiastic descriptions of the research of Lapicque and Bourguignon are presented.

These procedures can hardly be of interest to the general practitioner. The apparatus described is so complicated and so much effort is required to accomplish the procedure that there is small wonder at the lack of interest in the method.

The authors claim that modern methods of electrodiagnosis have increased understanding of certain neurophysiological correlations and that by this procedure minute lesions of the nervous system may be detected at an early stage. There is some doubt whether their argument that electrodiagnosis might be used to a greater extent is tenable. The procedure is so complicated that it precludes the extensive use recommended by the authors.

The book provides very little which is new in the field of electrodiagnosis and the omission of a bibliography and index greatly weakens the presentation.

ULTRAKURZWELLEN IN IHREN MEDIZINISCH-BIOLOGISCHEN ANWENDUNGEN (Ultra-short Waves in Their Medical Biological Applications). By H. DANZER, H. E. HOLLMANN, B. RAJEWSKY, H. SCHAEFER, and SCHLIEPHAKE. Volume 1. ERGEBNISSE DER BIOPHYSIKALISCHEN FORSCHUNG (Results of Biophysical Research). Edited by Prof. Dr. B. RAJEWSKY. A volume of 308 pages, with 188 illustrations and 24 tables. Published by Georg Thieme, Leipzig, 1938. Price: 19.00 R.M. (paper), 21.00 R.M. (bound), 25 per cent discount to foreign purchasers.

Under the editorship of B. Rajewsky, who is head of the Kaiser Wilhelm Institute for Biophysics at the University of Frankfurt, there will be published a series of monographs dealing with the recent advances made in this field. Since papers on that subject are not too easy to locate because they are scattered throughout the literature, such an undertaking will be well worthwhile. The first volume, which just appeared, covers ultra-short electric waves and contains the following contributions: Biophysical Problems (Rajewsky), Physical and Technical Principles (H. Schaefer), The Effect of Ultra-short Waves on Living Tissue (Rajewsky), A Theoretical Analysis of the Effect of High Frequency Fields on Biological Objects (Danzer), The Positioning of the Patient during Exposure to Ultra-short Waves (Hollmann), Résumé of the Indications for the Use of Ultra-short Waves (Schliephake). There is no doubt that this book fills a definite gap in our medical literature. It should be of special interest to the physician specializing in physical therapy, who will find there a good deal of valuable information.

GRUNDLAGEN DER RÖNTGENDIAGNOSTIK UND RÖNTGENTHERAPIE (Fundamental Principles of Roentgen Diagnosis and Roentgen Therapy). By DR. G. SCHULTE and DR. F. KUHLMANN. A volume of 140 pages with 148 illustrations. Published by Georg Thieme, Leipzig, 1939. Price: Paper, 7.50 R.M.; bound, 8.50 R.M. (25 per cent discount to foreign purchasers).

This book has been prepared for the medical student as a companion to his lectures on the fundamental aspects of roentgenology and for the non-radiologist who wishes a brief introductory text written in simple language. That the subject matter had to be presented, therefore, in highly condensed form is obvious.

Following a short chapter on physical and technical principles which include a clever schematic illustration of the photographic process from exposure to final roentgenogram, the diagnostic roentgenology of bones and joints, lung, heart, aorta, digestive tract, gall bladder, pancreas, and genito-urinary tract is discussed. A large portion of the available space is devoted to the skeleton, its normal appearance in the roentgenogram, and its pathological conditions, thus leaving relatively little room for the remaining organs and organ systems. The fundamentals of roentgen therapy are outlined in 17 pages and, though of necessity brief, are presented in a concise manner and suffice for the beginner. The illustrations are well executed, and as a first introduction to roentgenology this book can be recommended.

END-RESULTS IN THE TREATMENT OF GASTRIC CANCER. By EDWARD M. LIVINGSTON, B.Sc., M.D., Associate Visiting Surgeon, Bellevue Hospital, New York; Assistant Clinical Professor of Surgery, New York University College of Medicine; formerly Visiting Surgeon, New York City Cancer Institute, and GEORGE T. PACK, B.Sc., M.D., F A.C.S., Attending Surgeon, Memorial Hospital, New York City; Assistant Professor of Clinical Surgery, The School of Medicine, Yale University, New Haven, and Cornell University Medical College, New York City. A volume of 179 pages with 30 charts and six figures. Published by Paul B. Hoeber, Inc., New York City, 1939. Price: $3.00.

The monograph serves a very useful purpose in presenting the various operability and mortality rates in cases of carcinoma of the stomach. Special charts and tables show the mortality rates in a collected series of 12,000 cases in which partial gastrectomy was performed and the average rates in reports from all sources and in all periods. A natural "yardstick" is given for the measure of the cures. Results of special follow-up studies made three, five, and ten years after operation are given.

There is an excellent foreword by Bowman C. Crowell, M.D., Associate Director, American College of Surgeons, who states that "the numerical importance of gastric cancers places this study among the most significant that could have been made in the cancer field in the present state of our knowledge of the subject... Surgeon, internist, radiologist, and general practitioner should profit from this study."

ABSTRACTS OF CURRENT LITERATURE

CONTENTS BY SUBJECT

THE FOLLOWING ABSTRACTORS HAVE CONTRIBUTED TO THIS ISSUE

S. RICHARD BEATTY, M.D., of Denver, Colo.
RAY A. CARTER, M.D., of Los Angeles, Calif.
JAMES J. CLARK, M.D., of Atlanta, Ga.
MAX CLIMAN, M.D., of Hartford, Conn.
BENJAMIN COPLEMAN, M.D., of Perth Amboy, N. J.
SYDNEY J. HAWLEY, M.D., of Danville, Penna.
LEWIS G. JACOBS, M.D., of Winona, Minn.
EUGENE T. LEDDY, M.D., of Rochester, Minn.
JOHN B. MCANENY, M.D., of Madison, Wis.
MAX MASS, M.D., of Chicago, Ill.
ANTONIO MAYORAL, M.D., of New Orleans, La.
JOHN G. MENVILLE, M.D., of New Orleans, La.
JOHN M. MILES, M.D., of Lafayette, La.
R. R. NEWELL, M.D., of San Francisco, Calif.
LESTER W. PAUL, M.D., of Madison, Wis.
ERNST A. SCHMIDT, M.D., of Denver, Colo.
CHARLES G. SUTHERLAND, M.D., of Rochester, Minn.

ABSTRACTS IN THIS ISSUE LISTED ALPHABETICALLY BY AUTHORS

GENITO-URINARY TRACT (THERAPY)

Spermatocele, Including its X-ray Treatment. Charles Huggins and W. J. Noonan. Jour. Urol., **39,** 784–790, June, 1938.

The authors present eight cases of spermatocele treated by 600 roentgens in two or three treatments at one- or two-day intervals. They found that the spermatocele always disappeared following x-ray therapy to the involved testis and without loss of sexual potency or libido.

Because sterilization occurs, x-ray therapy is advised only in cases in which fertility is undesirable, as in older men.

JOHN G. MENVILLE, M.D.

Intravenous Urography. Fred M. Hodges. South. Med. Jour., **32,** 150–154, February, 1939.

Sufficient use is not being made of intravenous urography. Care and proper technic are indispensable to a satisfactory examination. Frequent examinations will disclose unsuspected and unexpected kidney lesions. Intravenous urography is particularly useful in obscure abdominal cases and in patients in whom the symptoms are not severe enough to justify a general urologic examination.

JOHN M. MILES, M.D.

Roentgen and Radium Therapy in Affections of the Genito-urinary Tract in the Male. Alessandro Bianchini. Arch. di Radiol., **14,** 30–68, January-February, 1938.

This is a review of the modern views of the value of radiotherapy in urology. Although the subject is well presented it could be improved by a bibliography.

E. T. LEDDY, M.D.

Cystography, Especially Pneumocystography, as a Guide in Treatment of Vesical Neck Lesions. T. H. Sweetser. Jour. Urol., **40,** 285–293, August, 1938.

The author stresses the fact that proper interpretation of cystography in association with digital rectal examination with a catheter in place affords not only valuable information but permits one to plan the method of treatment with almost no disturbance of the patient.

Cystograms were made with from 30 to 90 c.c. of air, from 30 to 90 c.c. of 1.5 per cent sodium iodide, and a small amount of stronger skiodan. There are 24 illustrations.

JOHN G. MENVILLE, M.D.

GRANULOMA

Gangrenescent Granuloma and its Treatment with Vitamin C and Roentgen Rays. E. Heinermann. München. med. Wchnschr., **85,** 2023, 2024, Dec. 30, 1938.

This disease was first described by Wirth and Henning and by Kraus. It is rare (28 reported cases) and found mostly in males. It generally starts in the nasal cavity, but may originate in the soft palate, throat, or mucosa of the cheeks. The course runs from two months to five years, and leads to a fatal termination through cachexia, sepsis, pneumonia, erysipelas, meningitis, brain abscess, or hemorrhage. The gangrenous destruction leads to an ulcer with steep, slightly elevated walls with a bluish-red base and rather firm consistency. The surrounding centimeter of tissue is infiltrated, slightly elevated, and reddened. The general condition is poor, and fever is always present. The blood picture is not characteristic. Bacteriologic studies show a mixed group of non-pathogenic diphtheroids, staphylococci, and streptococci. Glanders, anthrax, tubercle bacilli, and spirochetes were not found. Regional glands are not usually enlarged, and the disease progresses deeply, to the bone at times. The etiology is unknown. Treatment has been by irradiation, anti-syphilitic therapy, detoxin, potassium iodide, and radical surgery with irradiation.

A case of a girl, 20 years of age, is reported, in which a vitamin C deficiency was discovered. Treatment with 5 c.c. cebione a day, intravenously, plus cebione tablets, combined with irradiation (2,500 r total to each of three fields, two lateral and one posteriorly about the neck, 10 × 15 cm. in size, 40 cm. F.S.D., 0.5 mm. Cu filter, 180 kv., 150 per field daily) resulted in a cure, complicated, however, by a pharyngeal stenosis. This was successfully dilated with bougies, and the patient has been symptom-free for over a year.

LEWIS G. JACOBS, M.D.

HEART AND VASCULAR SYSTEM

Rupture of the Right Auricle. R. Nicolini, A. Battro, and R. Latienda. Rev. Argent. de Cardiol., **5,** 182–187, July and August, 1938.

Ruptures of the cardiac chambers are comparatively rare. Up to 1938, only 710 cases had been reported. The left ventricle is the chamber most frequently ruptured, then the right, and finally the auricles. Clowe, Kellert, and Gorham, however, collected 55 cases of ruptures of the cardiac muscle but none of these was of the ventricles.

The authors believe that coronary infarcts are the cause of all non-traumatic ruptures.

The article presents a case report of a 57-year-old male whose only complaint was pain in the gall-bladder region appearing four hours after meals every sixth or seventh day. The heart was essentially negative; the lungs revealed friction rubs and sibilant râles. There was tumefaction in the region of the gall bladder. Cholecystograms revealed calculous cholecystitis. Some blood and a few pus cells were found in the urine. Urea, blood sugar, and blood count were negative. The Wassermann test was negative. The clinical diagnosis was cholecystitis.

A cholecystectomy was done. The day following, the patient suffered a sudden circulatory collapse with high pulse (rate 145) and low arterial tension. He did not rally and died 14 hours later.

Autopsy revealed a new moon-shaped rupture of the right auricle with an extensive hemo-pericarditis that caused death by compression of the heart muscle. The correct diagnosis was not made before death.

ANTONIO MAYORAL, M.D.

Dissecting Aneurysms of the Aorta and the Iliac Artery, with an Unusual Case of Spurious Aneurysm. Sven Roland Kjellberg. Acta Radiol., **19,** 273–284, September, 1938.

Two cases of dissecting aneurysms of the abdominal aorta and a case of aneurysm of the iliac artery were diagnosed by x-ray examination. In all three cases retroperitoneal hemorrhage had obscured the outlines of the psoas muscles and of the kidney. Calcareous plaques in the wall of the aneurysm further aided in the radiological diagnosis.

In the case of spurious aneurysm, a rounded hernia-like protrusion of the posterior portion of the diaphragm had simulated a tumor.

ERNST A. SCHMIDT, M.D.

Rheumatic Heart Disease in Children. Jerome G. Kaufman. Jour. Med. Soc. New Jersey, **35,** 525–531, September, 1938.

This paper is primarily a clinical study of the rheumatic heart. A roentgenographic analysis of an apparently large series in children reveals, in the following sequence: (1) An accentuation of the left auricle; (2) A straightening of the left auriculo-pulmonic curve due to the enlargement of the conus and pulmonary artery, and (3) A further enlargement of the auricle posteriorly and to the right, with an encroachment on the esophagus and diminution of the retrocardiac space.

The right auricle may also be enlarged, especially in stenosis, but the left ventricle may or may not be enlarged, depending on the type and degree of lesion. Because of the straightening of the left auriculo-pulmonic curve, the aortic knob appears receded and the descending aorta may be obscured.

The author cautions against the error of confusing long-rotated, narrow, dropped heart with a mitral configuration. Even a straightening of the auriculo-pulmonic curve may be seen in such cases.

In the combined lesions, the left ventricle becomes enlarged; the apex tends to point downward, and the long axis of the ventricle becomes more oblique.

MAX MASS, M.D.

HEMORRHAGE

Extradural Hemorrhage. K. G. McKenzie. British Jour. Surg., **26,** 346–365, October, 1938.

Extradural hemorrhage usually arises from a rupture of the anterior branch of the middle meningeal artery. It is an infrequent lesion and the author reports 20 cases which he has seen during the past 10 years. The syndrome is characterized by a lucid interval following a short period of immediate partial or complete unconsciousness. The lucid interval may be prolonged and confuse the diagnosis. There are three important lateralizing signs:

(1) Edema of the scalp in the temporal fossa, suggesting a linear fracture which can be confirmed by x-ray examination.

(2) A dilated fixed pupil on the side of the lesion.

(3) A positive Babinski and diminution of active movement of the arm and leg on the side opposite to the lesion.

In this series of 20 cases there was fracture on the side of the lesion in 19 cases and in one case there was no fracture. Extradural hemorrhage rarely occurs without fracture, and absence of a linear fracture in x-ray films is strong evidence against this lesion.

The cerebrospinal fluid is clear or faintly blood-tinged. If it is very bloody, the diagnosis is in doubt, as the syndrome may be produced by the bruising or laceration of the brain.

Extradural hemorrhage is a serious lesion and the mortality rate will be high unless there is accurate early diagnosis and prompt treatment.

MAX CLIMAN, M.D.

THE HIP JOINT

Hip Deformities in Adults. F. Campbell Golding. Proc. Royal Soc. Med., **31,** 940–942, June, 1938.

Deformities such as are described in this article may be recently acquired, or may follow juvenile disease. Congenital dislocation, pseudo-coxalgia, slipped epiphysis, and old infections of the hip will almost certainly have osteo-arthritis engrafted upon their deformities.

Tuberculosis of the hip has its maximum age incidence between three and seven years, and is not common in the adult. In deciding whether or not there has been infantile tuberculosis we consider that after that disease—

1. Complete and perfect ankylosis is unlikely, except by secondary infection or operation, because healing is slow and incomplete.

2. Trabeculations are dense and widely spaced, and the joint below the site of disease is similarly affected.

3. Small, irregular, dense, homogeneous calcifications tend to persist indefinitely at the joint space.

Metaphyseal and ischial lesions of tuberculosis must be distinguished from those of osteomyelitis and cyst.

Gonococcal infection is illustrated by a case resembling coxa plana. Pathognomonic features are not available, and diagnosis is difficult.

The diagnosis of Charcot's joint is usually fairly obvious. Early stages may be seen by radiographing asymptomatic joints of patients having a frank lesion. Fifty per cent of the author's cases were Wassermann-negative reactions. Both hypertrophic and atrophic manifestations are seen, one of the author's patients

having hypertrophic changes in one joint and atrophic in another.

Orthopedic devices frequently make the examination of cases of trauma difficult. A case is illustrated in which, after dislocation, many osteophytes formed in soft tissues about the hip.

Protrusio acetabuli depends only on malacias of the acetabulum, which may be classified as (1) destructive disease such as syphilis, tuberculosis, Paget's disease, sepsis, neoplasm, or echinococcus; (2) the rheumatic group which includes non-specific infection, rheumatoid arthritis, gonorrhea, and, questionably so grouped, osteo-arthritis, and (3) a peculiar group of unknown etiology, thought to arise early in life, featuring a thin acetabular wall and intact cartilage. The head may be deeply buried. The deformity, once established, does not appear to increase. Etiology is unknown. The author is unable to accept the usual theory of traumatic origin in 23 of his cases.

Rheumatoid arthritis features partial or complete loss of cartilage, general subchondral changes, decalcification of senile type, and great similarity of appearance in all cases.

Osteo-arthritis features loss of cartilage at the weight-bearing points, sclerosis and new formation of bone, cavitation of bone, a tendency of the head to move out of the acetabulum, and deposition of new bone in the acetabulum forming on the head of the femur. Considering the discussion, whether the displacement of the head precedes or follows the deposition, the author cites that 53 per cent of his cases had displacement and 39 per cent deposition. This may indicate that displacement comes first.

RAY A. CARTER, M.D.

HODGKIN'S DISEASE

Hodgkin's Disease and Allied Disorders. Henry Jackson, Jr. New England Jour. Med., **220,** 26–30, Jan. 5, 1939.

Hodgkin's disease and its allied disorders may be grouped collectively under the term of malignant lymphoma and include Hodgkin's disease, lymphosarcoma, reticulum-cell sarcoma, and giant-follicle lymphoma.

In lymphosarcoma, the lymph node is diffusely invaded by lymphocytes, mostly mature. The capsule and adjacent structures may be invaded, and the blood may show a lymphatic leukemic state.

Reticulum-cell sarcoma shows large, pale, ameboid cells with irregular outline and a vesicular nucleus. Eosinophils are not found, fibrosis is rare, but invasion occurs.

In Hodgkin's lymphoma, the lymph node structure is replaced by a diffusion of mature lymphocytes with scattered Reed-Sternberg cells. Neither eosinophilia, fibrosis, nor necrosis occurs.

Hodgkin's granuloma shows fibrosis, eosinophilia, necrosis with neutrophils, and Reed-Sternberg cells.

Hodgkin's sarcoma shows invasion of tissue with large cells of uniform size and basophilic cytoplasm. The nuclei are round with a prominent nucleolus. Eosinophils are not found but Reed-Sternberg cells are present.

Giant-cell lymphoma presents lymph nodes with widely scattered germinal centers composed of uniform rapidly growing cells of uncertain origin. Necrosis, neutrophilia, and phagocytosis are absent. This condition may evolve into one of the other allied disorders.

The etiology of this group of disorders remains unknown. There is no limitation to age groups. Males are more frequently affected than females.

Any organ or tissue may be involved in these processes but the lymph nodes are most frequently affected. Secondary involvement of bone occurs in 25 per cent of Hodgkin's disease. Malignant lymphoma of some form involves the gastro-intestinal tract in 25 per cent of the cases. Mediastinal involvement is frequent.

Symptomatology is variable as might be expected. Lymph node enlargement, pain, fatigue, sore throat, dyspnea, cough, fever, weight loss, generalized itching, and amenorrhea are usual symptoms. Blood examination is rarely of help. Biopsy is essential to diagnosis.

Surgery alone may rarely be of value. Irradiation is the standard method of treatment but should be under the direction of a competent radiotherapist. No preference as to restricted or generalized irradiation is had. It is recommended that from 200 to 800 r at 250 kv. be given in divided doses, treating when node enlargement is present.

It is firmly believed that irradiation prolongs life, and adds to the comfort of these patients. Supportive treatment is insisted upon. The average length of life of these patients after onset of the disease is two and one-half years, but some patients have lived more than ten years. Hodgkin's lymphoma has the best life expectancy with 20 per cent living ten years.

J. B. MCANENY, M.D.

A Case of Hodgkin's Disease with Massive Collapse and Cavitation of the Lung. B. L. Hardin, Jr. Am. Jour. Med. Sci., **197,** 92–99, January, 1939.

Although compression of the superior vena cava and trachea occur so often in Hodgkin's disease, partial or complete bronchial occlusion by enlarged bronchial or mediastinal nodes are uncommon. When this condition is found, the obstruction is not due to extrabronchial pressure, but to endobronchial protrusion of granulomatous placques.

The first case of massive pulmonary collapse due to Hodgkin's disease, reported in 1932, was due to invasion of the left main bronchus from a huge mass of nodes about the tracheal bifurcation. The second case, reported in 1934, was due to an endobronchial polyp made up of Hodgkin's tissue. A large pleural effusion was present in each case.

In this article a case of Hodgkin's disease is reported in which pulmonary excavation and massive collapse

occurred, the bronchial constriction being due to granulomatous infiltration. The mechanism of the cavitation was not clear. Although excavation, when it occurs in Hodgkin's disease, has been considered to be due to radiotherapy, it has also been described as occurring spontaneously. In this case cavities also occurred in the untreated lung.

The variability of the atelectasis was an interesting feature in this case. The accumulation of mucus behind the constriction at times rendered the all but complete obstruction wholly so.

Although the bronchitis which occurs may be regarded by the pathologist as a simple acute or simple chronic form, frequently its specific nature is suggested by the placque-like opacities in various portions of the mucosa, or by the elevated areas or bulky nodular outgrowths which narrow the lumen considerably.

BENJAMIN COPLEMAN, M.D.

INDUSTRIAL DISEASES

Radiological Demonstration of Pathological Changes Induced by Certain Industrial Processes. James F. Brailsford. British Jour. Radiol., **11,** 393–400, June, 1938.

Disease process due to industrial causes may be missed because affected workers have different doctors. The radiologist holds an unique position in this capacity as he may correlate the findings in a great number of patients. One important recent discovery in this respect has been that of the effect of fluorine on the bones of workers, particularly in workers in cryolite. The first changes are noticed only in the pelvis and lumbar spine, which show a slight increase in density. The trabeculæ appear rough and blurred. Later the cancellous structure appears to fuse so that a dense structureless film is observed. Still later the bone presents a diffuse marble-white shadow, in which details cannot be distinguished. When this supervenes, changes are seen in all the bones. Irregular periosteal excrescences are seen frequently. The degree of change depends roughly upon the length of time the worker has been working with fluorine. The first signs were discovered in workers who had been working for about nine years. There are numerous exceptions to this time period, due to the different concentrations of the dust. In spite of these bone changes in cryolite workers, the morbidity was not any higher than in other industries.

All patients who have injury to bones or joints, even minor ones, should be x-rayed as soon as possible after the injury. Not infrequently radiographic evidence at a later date suggests that the lesion was present before the injury and that trauma had done little more than call attention to it. Bone changes may take place as the result of repeated small grades of trauma which are, in themselves, insufficient to produce injury. Therefore, it is important to have early and frequent radiographic examinations.

Radiographs of the lungs of workers who are entering an employment in which there are apt to be changes due to the inhalation of dust, should be made at the beginning of employment. Such an examination may be invaluable later in assessing the amount of change due to dust inhalation. It is not possible to fix the degree of disability from the x-ray examination of silicosis cases. It is frequently found that patients with advanced changes evidenced by roentgen-ray examination show little or no clinical symptoms, and, conversely, it usually happens that a patient shows very little change on the x-ray examination but may have profound disability.

SYDNEY J. HAWLEY, M.D.

THE INTESTINES

Duration of Intestinal Transit in the Normal Individual. Guénaux and Vasselle. Bull. et mém. Soc. de radiol. méd. de France, **26,** 319–324, May, 1938.

Investigations of normal individuals with opaque meals have shown that there is a period of filling of the colon and a period of evacuation. A given meal does not pass through the intestine as a whole; it is divided into parts. The evacuation of a given day's meals requires two stools, one from 12 to 24 hours, the other from 36 to 44 hours after ingestion. The maximum time is 48 hours and this limit marks the division between the normal state and a state of constipation.

S. R. BEATTY, M.D.

The Roentgen Diagnosis of Intestinal Obstruction. Andreas Hoyer. Acta Radiol., **19,** 409–432, November, 1938.

Hoyer describes his technic in the determination of intestinal obstruction which enabled him to give a correct diagnosis in 100 per cent of his cases. Both fluoroscopy and radiography are used with the patient in the erect position. In all cases the examination by contrast medium could be dispensed with, and in the majority of cases the site of lesion could be ascertained fairly accurately. The interpretation of the x-ray appearance relied on the characteristic findings of fluid levels in the occluded intestines. In addition, the importance of gas accumulation, especially in the colon, is emphasized. In contradistinction to the clinical symptoms which are frequently vague and inconclusive in the initial stages of the disease, the x-ray examination is able to furnish valuable conclusions concerning presence and location of intestinal obstruction a very short time after its onset.

ERNST A. SCHMIDT, M.D.

Emphysema of the Cecum and Ascending Colon. George Strenger. Jour. Am. Med. Assn., **110,** 1663, 1664, May 14, 1938.

This is a rare condition, there being only 95 reported cases. Other names for this medical rarity are "cystic pneumatosis," "pneumatosis cystoides," and "gas cysts of the bowel." The occurrence of a similar disturbance in the intestine of swine has been known since the early eighteenth century.

When the cecum is affected the intestine is covered

with many minute vesicles, its wall being greatly thickened and crepitant, having the feel of lung tissue. In the jejunum and ileum the gas cysts are usually larger, and may hang from the intestine and mesentery in grape-like clusters. These gas spaces or cysts are most numerous under the serosa and mucosa, although they are scattered throughout all the coats of the intestine. Microscopically they are lined with flattened endothelial-like cells and are surrounded by giant cells and lymphocytes. Usually there is some associated condition such as a peptic ulcer, tuberculosis, or ulcer of the cecum.

The pathogenesis of this bizarre condition is obscure. The most plausible etiologic theory is the mechanical one, postulating that gas is forced into the wall of the intestine through an ulcer or fissure in the mucosa. Of 42 published cases, 32 were associated with ulcers in the stomach or duodenum.

Peristaltic action forced the gas through the mucosal "breaks" into the other layers of the intestine.

Emphysema of the intestine has never been diagnosed pre-operatively. In the majority of cases the clinical diagnosis was intussusception or appendical abscess.

CHARLES G. SUTHERLAND, M.D.

Co-existence of "Common Mesentery" and Spontaneous Pneumothorax in a Patient with Duodenal Stenosis Due to Compression by the Gall Bladder. J. Jalet and M. André. Bull. et mém. Soc. de radiol. méd. de France, **26**, 451–453, July, 1938.

The authors describe their findings in a case of duodenal stenosis due to pressure of the gall bladder on the third part of the duodenum, which was situated on the right. Further examination revealed that the small intestine was entirely to the right of the midline, the large bowel occupying the left half of the peritoneal cavity. Incidentally, the patient was found to have a partial pneumothorax which later became complete. Relief from symptoms due to the duodenal stenosis followed surgery.

S. R. BEATTY, M.D.

A Case of Intestinal Invagination Reduced by a Barium Enema. J. Nebout, E. Dechambre, and S. Dechambre. Bull. et mém. Soc. de radiol. méd. de France, **26**, 377–379, May, 1938.

The authors relate their experience in reducing an ilio-colic invagination in an infant ten months of age. Fluoroscopic and radiographic observation assisted in a successful reduction. An attempt at reduction of an invagination is justified in every case, as the procedure, if unsuccessful as a therapeutic measure, is a valuable diagnostic aid.

S. R. BEATTY, M.D.

A Case of Complete Volvulus of the Sigmoid without Strangulation and with Insignificant Symptoms. Bengt S. Holmgren. Acta Radiol., **19**, 230–238, September, 1938.

The author describes a case of a 360 degree volvulus of the sigmoid in which neither strangulation nor meteorism was present. The patient complained of constipation of several years' standing. In addition to the acute volvulus, an ulcer of the duodenal bulb was discovered by roentgen examination. Reduction of the volvulus was accomplished by means of a barium enema under fluoroscopic guidance. Holmgren points out that chronic and subacute conditions of volvulus are probably considerably more frequent that is ordinarily assumed.

ERNST A. SCHMIDT, M.D.

An Unusual Case of Intestinal Obstruction. Walter O. Paulson and L. M. Garrett. Wisconsin Med. Jour., **37**, 1001–1004, November, 1938.

The authors report a case of intestinal obstruction in a new-born infant due to a congenital membrane in the jejunum. Roentgen examination four days after birth revealed a dilated stomach, a wide dilatation of the duodenum, and a short segment of jejunum, ending in a complete obstruction. Autopsy showed the obstruction to be due to a thin delicate membrane which extended completely across the lumen of the bowel at this point.

In a review of the literature no mention of this particular type of congenital obstructive lesion was found. Roentgenograms and photographs of post-mortem specimen are included.

LESTER W. PAUL, M.D.

THE LIVER

Calcified Hydatid Cysts of the Liver in the Roentgenogram. Alina Kowalska-Smigielska. Polski Przegl. Radiol., **13**, 139–144, 1938.

The author presents the case of a 43-year-old patient suffering from attacks of pain in the right epigastrium accompanied by fever and icterus. The roentgenogram showed numerous rounded calcifications in the liver region. The liver itself was enlarged.

The assumption of echinococcus disease was confirmed by the history of the case and the positive cuti-reaction.

ERNST A. SCHMIDT, M.D.

The Clinical and Roentgenological Diagnosis of Echinococcus Alveolaris of the Liver. B. Steinmann. Schweiz. med. Wchnschr., **68**, 1411–1415, Dec. 31, 1938.

The author reports, in detail, a case of echinococcus alveolaris of the liver, complicated by pulmonary tuberculosis, in which the diagnosis was manifested by hepatic calcifications observed roentgenologically. He believes this diagnosis could be made more frequently if a roentgenologic study, with this in mind, and antigenic reactions are used. The diagnosis must be considered when the clinical picture suggests primary or metastatic liver carcinoma, but there is no tumor; or when no cause can be found for a severe icterus. Other causes of hepatic calcification are said to be very rare. The article presents a brief discussion of

the geographic distribution of this disease in Switzerland and the neighboring portions of France and Germany.

LEWIS G. JACOBS, M.D.

Liver Abscesses: Report of Three Cases. W. Francis Martin. South. Med. and Surg., **101,** 66–68, February, 1939.

About 75 per cent of liver abscesses are amebic and the remaining 25 per cent are pyogenic. Both may occur solitary or multiple. The author discusses the symptoms, diagnosis, and treatment, and reports three cases. Roentgen examination in one case revealed elevation and immobility of the diaphragm and some signs of rupture into the lung, and, in another case, showed enlargement of the liver and a defect in the transverse colon, suggestive of amebic infection.

L. W. PAUL, M.D.

THE LUNGS

Pulmonary Tomography: Inadequacy of Radiography. Camino. Bull. et mém. Soc. de radiol. méd. de France, **26,** 392–395, June, 1938.

A series of tomographs of the chest are presented to demonstrate the value of this method in showing lesions not visualized by ordinary radiographic technics.

S. R. BEATTY, M.D.

Miliary Lesions of the Lung, Roentgenographically Considered. Ray A. Carter. California and West. Med., **50,** 94–98, February, 1939.

The author describes many different conditions which may produce miliary lesions in the lungs, which are demonstrable on the x-ray film. He believes that the miliary appearance is most frequently due to tuberculous or nodular silicosis, and occasionally, miliary carcinomatosis, and that there are many other causes which cannot be differentiated by x-ray examination without a thorough history and study of the clinical and laboratory findings.

JAMES J. CLARK, M.D.

Result of the Radiologic Survey of the Schools of Charleville. Blairon. Bull. et mém. Soc. de radiol. méd. de France, **26,** 551–559, October, 1938.

A radioscopic survey of 3,000 children of the schools of Charleville (France) made possible the demonstration of some type of pathology in 52 per cent. There was some type of involvement of the lung or pleura in 2 per cent, 30 per cent had enlargement of the hilar shadows, 8 per cent had abnormalities of the spine, and in 12 per cent there was some abnormality of the cardiac shadow.

Blairon urges the necessity of a program of yearly fluoroscopic study of all students of the public schools of France. He believes that fluoroscopy is an adequate means of diagnosis when practised by radiologists of at least five years' experience. Examinations can be made rapidly, only four or five seconds sufficing in most cases, and the children need not be undressed. While fluoroscopy is admittedly less desirable than radiography, it is much better than physical examination alone, but should be used as a complement to clinical studies. The expense of radiography is prohibitive.

The comments of the other members of the Society are interesting. Radioscopy is inadequate from the diagnostic standpoint, particularly when such large numbers of children are to be examined in rapid succession, as inaccuracies are bound to occur with visual fatigue. The clothing should by all means be removed. There are few radiologists of sufficient experience relative to the number of examinations that would be made, and it is quite certain that these men would be the last ones considered to conduct such a survey.

S. R. BEATTY, M.D.

The Place of Serioscopy in the Practice of Phthisiology. Bonte and Warembourg. Bull. et mém. Soc. de radiol. méd. de France, **26,** 401, 402, June, 1938.

The authors find serioscopy an invaluable aid in the study of the thorax. Lesions otherwise unseen can be demonstrated and accurate localization made possible.

S. R. BEATTY, M.D.

PHYSICS OF RADIATION

A Determination of e/m from the Refraction of X-ray in a Diamond Prism. J. A. Bearden. Phys. Rev., **54,** 698–704, Nov. 1, 1938.

The ratio of the electric charge on an electron to its mass is, of course, one of the fundamental physical constants. There are many ways of determining this constant. The present paper describes an experimental determination by observing the amount of refraction of x-ray (the copper K_β line) in a diamond prism. The author comes out with good agreement with other measurements of the constant.

This is interesting to a radiologist because of the actual use of refraction of x-ray, which is, of course, a very small effect indeed. It is also interesting because the use of a polished diamond prism had proved sufficiently exciting so that descriptions of the experiments have appeared in the daily papers.

R. R. NEWELL, M.D.

The Paths of Ions in the Cyclotron. L. H. Thomas. Phys. Rev., **54,** 580–598, Oct. 15, 1938.

This article concerns the question of the limitation of energy which can be given to an ion accelerated in the cyclotron, because as it gets to extremely high speed the relativity effect of apparent increase in mass upsets the balance required for proper focusing. Thomas shows how it is possible to escape from this limitation by making the magnetic field radially asymmetrical, that is, making it vary with the polar angle.

R. R. NEWELL, M.D.

RADIATION

Geometrical Factors in the Measurement of Radiation in Roentgens. C. C. Lauritsen. British Jour. Radiol., **11,** 471–478, July, 1938.

There are two ambiguities in the definition of the roentgen: (1) the definition does not state whether scattered radiation shall or shall not be included in the measurement, and (2) the definition is based on the ionization produced per c.c. of air. It is customary and convenient to measure instead the ionization produced in an unknown volume by the electrons originating per c.c. of air at a certain point, which is a different thing.

If radiation has long wave length, or the medium used is solid, the electrons produced during radiation have a short path, and ionization may be regarded as taking place at the point where the energy of radiation is converted into the kinetic energy of the electron. This is not true with short length radiation, or if the medium is air, as many of the ions will be produced a long way from the point of conversion of energy of radiation. In special cases in air, the ions which escape from a given volume will be exactly equaled by those reaching that volume but produced elsewhere. When this happens, compensation has taken place, but this is not usually the case. A wide beam of parallel radiation will give compensation, but it is complicated by the presence of scattered radiation. The measurement of ionization in a wide beam, does not, therefore, give a unique determination of the intensity at the source.

In a narrow beam, such as is commonly used with an open chamber, compensation is far from complete, so that we do not measure the number of ions produced in a known volume in the beam, but rather the ionization produced in an unknown volume in and around the beam, produced by electrons equivalent in number and energy to those ejected in a known volume in the beam. It is usually agreed that this procedure is appropriate for the measurement of quantity of radiation in roentgens, and usage has established the roentgen on these terms, rather than those of the definition.

If radiation from a point source is to be measured, as from a small quantity of radium, it is evident that it is more convenient to define the roentgen in terms of energy converted, rather than in terms of ionization. If we consider spherical shells of air of equal thickness surrounding the source, it is obvious that the primary energy converted into kinetic energy is the same for all shells, but the ionization per shell varies in a complicated manner with the distance. So, if the roentgen is defined in terms of energy converted, then intensity is simply inversely proportional to the square of the distance. The operation of this principle is illustrated mathematically.

S. J. Hawley, M.D.

Physical Measurements in High Voltage X-ray Therapy. Ralph Phillips and G. S. Innes. British Jour. Radiol., **11,** 498–503, July, 1938.

Physical aspects of x-rays produced at 700 kv. are reported. The authors consider the voltage correct within plus or minus 1 per cent. At 100 cm. distance the intensity in free air is 13 r per minute per milliampere. Absorption curves for iron, copper, tin, lead, and a compound filter of lead, tin, copper, and aluminium are given. Half and quarter value layers in copper, tin, and wax are given. Curves showing variation of percentage back-scatter at the surface with voltage from 200 to 700 kv. are given and also variation of back-scatter with focal skin distance and field area. An isodose curve for a 10 × 10 cm. field at 60 cm. S.T.D. is given. Curves showing variations of percentage depth dose at 10 cm. with field area, focal skin distance, filtration, and voltage are given.

S. J. Hawley, M.D.